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State of Connecticut

REPORT

OF

The Connecticut Agricultural Experiment Station

FOR THE YEAR 1903

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PUBLIC DOCUMENT No. 24

TWENTY-SEVENTH ANNUAL REPORT

OF

The Connecticut Agricultural Experiment Station

FOR THE YEAR ENDING OCTOBER 31

1903

PRINTED BY ORDER OF THE LEGISLATURE

The publications of this Station are sent free to every citizen of Connecticut who applies for them. Address, The Conn. Agricultural Experiment Station, New Haven, Conn.

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THE TUTTLE, MOREHOUSE & TAYLOR COMPANY
1904

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CONNECTICUT AGRICULTURAL EXPERIMENT STATION.

OFFICERS AND STAFF.

STATE BOARD OF CONTROL.

Ex officio.
His Excellency ABIRAM CHAMBERLAIN, Meriden, *President.*
E. H. JENKINS, New Haven, *Director and Treasurer.*

Appointed by Connecticut State Agricultural Society: Term expires
B. W. COLLINS, Meriden. July 1, 1906

Appointed by Board of Trustees of Wesleyan University:
Prof. W. O. ATWATER, Middletown. 1906

Appointed by Governor:
EDWIN HOYT, New Canaan. 1904
JAMES H. WEBB, Hamden. 1905

Appointed by Board of Agriculture:
T. S. GOLD, West Cornwall, *Vice-President.* 1904

Appointed by Governing Board of Sheffield Scientific School:
W. H. BREWER, New Haven, *Secretary.* 1905

STATION STAFF.

Chemists.
Analytical Laboratory.
A. L. WINTON, PH.B., *Chemist in charge.*
A. W. OGDEN, PH.B. M. SILVERMAN, PH.B.
E. MONROE BAILEY, PH.B.

Laboratory for the Study of Proteids.
T. B. OSBORNE, PH.D., *Chemist in charge.*
I. F. HARRIS, B.S.

Botanist.
G. P. CLINTON, S.D.

Entomologist.
W. E. BRITTON, B.S.

Assistant to the Entomologist.
B. H. WALDEN, B.AGR.

In charge of Forestry Work.
WALTER MULFORD, F.E.

Grass Gardener.
JAMES B. OLCOTT, *South Manchester.*

Stenographers and Clerks.
Miss V. E. COLE.
Miss L. M. BRAUTLECHT.

In charge of Buildings and Grounds.
WILLIAM VEITCH.

Laboratory Helpers.
HUGO LANGE. WILLIAM POKROB.

Sampling Agent.
V. L. CHURCHILL, New Haven.

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The Station.

TABLE OF CONTENTS.

PAGE
Title Page i
Officers and Staff ii
Contents iii
Announcement vii
Report of Board of Control ix
Report of Treasurer xiii
Commercial Fertilizers 1
  Duties of Manufacturers and Dealers 1
  Observance of the Fertilizer Law 2
  Duties of the Station 8
  Sampling and Collection of Fertilizers 8
  Explanations concerning Analysis and Valuation 11
    Nitrate of Potash 18
    Nitrate of Soda 18
    Sulphate of Ammonia 19
    Dried Blood 20
    Cotton Seed Meal 20
    Castor Pomace 27
    Dissolved Rock Phosphate 27
    Carbonate of Potash 30
    Use of Carbonate of Potash as a Tobacco Fertilizer 31
    High Grade Sulphate of Potash 33
    Double Sulphate of Potash 33
    Muriate of Potash 33
    Kainit 33
    Bone Manures 35
    Slaughter House Tankage 37
    Dry Ground Fish 37
    Bone and Potash 41
    Nitrogenous Superphosphates and Guanos 43
    Special Manures 64
    Special Tobacco Manures 86
    Home Mixtures 89
    Tobacco Stems 91
    Vegetable Ash and Ash Compounds 91
    Ashes of Tobacco Stalks 93
    Cotton Hull Ashes 93
    Wood Ashes 94
    Lime Kiln Ashes 95
    Oyster Shell Lime 95

Commercial Fertilizers:
        Sheep Manure 95
        Garbage Tankage 98
        Cocoanut Pith 98
    Review of the Fertilizer Market........ 99
    Explanation of Market Quotations........ 101
    Wholesale Prices of Fertilizing Materials........ 106
Report on Food Products........ 107
    Law regulating Manufacture and Sale of Food Products........ 108
    Food Definitions and Standards........ 108
    Chocolate and Other Products of the Cocoa Bean........ 123
    Coffee 145
    Lard 149
    Food Products Examined for Dairy Commissioner........ 156
    The Composition of Acheen and Lampong Black Pepper........ 158
    Anatomy and Identification of Darnel and Chess........ 165
    Anatomy of Certain Oil Seeds with special Reference to Examination of Cattle Foods........ 175
        Hemp Seed 175
        Cotton Seed 180
        Sesame Seed 187
        Madia Seed 190
        Niger Seed 193
        Poppy Seed 194
Report of State Entomologist........ 199
    Report of Receipts and Expenditures........ 199
    Law Relating to Insect Pests and Plant Diseases........ 200
    Organization, Equipment, etc........ 202
    Inspection of Nurseries 205
    List of Nursery Firms Receiving Certificates in 1903........ 205
    Notice to Nurserymen and Shippers........ 207
    Condition of Nurseries in 1903........ 208
    Fumigation of Nursery Stock........ 209
    Examination of Orchards, Gardens, etc........ 209
    Scale-infested Localities 210
    Mosquito Investigations 210
    Study of Tobacco Insects........ 210
    General Insect Review 210
        Meteorological Conditions 210
        Abundance of Plant-Lice 211
        Scale-Insects 212
        Tent-Caterpillar and Fall Web-Worm........ 212
        Scarcity of Potato Beetles........ 212
        Elm Leaf-Beetle less abundant........ 213
        Hickory Bark-Borer 213
        Other Insects 213
        Two New Beneficial Insects........ 213
        Chinese Lady-Beetle 214
        Periodical Cicada not observed........ 214

Identification of Insects ... 215
Sending Insects by Mail ... 224
Two Common Scale-insects of the Orchard ... 225
  The Scurfy Bark-louse ... 227
  The Oyster-shell Bark-louse ... 229
  Remedies ... 231
  Summary ... 232
Fighting the San José Scale-insect in 1903 ... 233
  Spraying Dormant Trees ... 233
    Experiments at Yalesville ... 234
    Westville Experiments ... 239
    Spraying at Southington ... 244
    New Haven Experiments ... 248
    Other Experiences ... 250
    Summer Spraying with Kerosene Emulsion ... 252
    Making the Lime, Sulphur and Salt Mixture ... 252
    Making the Lime and Sulphide of Potash Mixture ... 255
  Effect of the Lime and Sulphur Mixtures on the Skin ... 255
  Weather Notes ... 256
  Summary ... 256
Postal Card Bulletin on the San José Scale-insect and Elm Leaf-Beetle ... 258
The Green Apple Leaf Aphis ... 259
  Appearance and Life History ... 260
  Remedies ... 262
The Pear Psylla ... 262
  Relationship to Other Insects ... 263
  How the Pear Psylla Injures Trees ... 264
  Appearance and Life History ... 264
  Natural Enemies ... 265
  Remedial Treatment ... 265
The Onion Thrips ... 266
An Interesting Luminous Insect ... 268
The Imported Cabbage Butterfly or Cabbage Worm ... 271
The Native Currant Borer ... 272
Entomology in the Reports of the Connecticut Board of Agriculture ... 273
  References to Addresses and Notes concerning Insects ... 274
Notes ... 276
  Mexican Jumping Seeds ... 276
  "Disparene" a Remedy for the Asparagus Beetle ... 276
  Abundance of *Cingilia catenaria* ... 277
  Xyleborus celsus ... 278
  Strawberry Leaf Roller attacking Dewberries ... 278
  Fumigating to Kill San José Scale on Fruit Trees growing under glass ... 278

Report of the Botanist 279
  Diseases of Plants Cultivated in Connecticut 279
  Parasitic Fungi 283
    Nature 283
    Relation to Weather 285
    Inquiry and Loss caused by Fungi 285
    Classification of Fungi 287
    Prevention of Fungous Growth 290
      Selection of Stock 291
      Cleanliness 292
      Pruning 292
      Fungicides of Various Kinds 292
      Spraying Machinery 296
    Notes on Specific Troubles 297
Commercial Feeding Stuffs 371
  Law regarding Sale of Feeding Stuffs 371
  Explanations regarding Analysis of Feeding Stuffs 372
  Cotton Seed Meal 376
  Linseed Meal 377
  Wheat Products 378
  Corn Products 383
  Rye Feed 387
  Malt Sprouts and Distillers' Grains 387
  Oat Products 387
  Miscellaneous Mixed Feeds 388
  Proprietary Dairy and Stock Feeds 390
  Condimental Cattle Foods 391
  Digestibility of Feeding Stuffs 391
  The Purchase of Feeding Stuffs 393
  The Weight of One Quart of Various Feeds 397
  Analyses of Feeds 398
Observations on the Fertilization of Peach Orchards 428
Tests of the Vitality of Vegetable Seeds 432
Examination of Babcock Test Apparatus 439
Tobacco Work in 1904 440

ANNOUNCEMENT.

THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION was established in accordance with an Act of the General Assembly approved March 21, 1877, "for the purpose of promoting Agriculture by scientific investigation and experiment."

By subsequent legislative acts it is made the business of this station to analyze all the brands of commercial fertilizers sold in the state, as well as to examine commercial cattle feeds and articles used for human food or drink on sale in Connecticut, with reference to their adulterations. Provision is also made for the testing and marking by this station of all apparatus used in determining the price of milk and cream.

Through the State Entomologist, a member of the station staff, the station is required to make regular inspections of nurseries, to visit and examine orchards, nurseries, fields, gardens, or storehouses at the request of their owners to advise regarding treatment for insect pests, and to diffuse information on the subject.

Through the State Forester, also a member of its staff, the station is required to manage the state forest.

In addition to the work of "scientific investigation and experiment" in the service of agriculture, to the work required under special statutes above described, and to the expert work required by the Dairy Commissioner's office, the station analyzes and tests fertilizers, cattle-foods, seeds, milk, and other agricultural materials and products, identifies grasses, weeds, moulds, blights, mildews, useful or injurious insects, suggests methods of combating injurious fungus and insect pests, advises as to the planting, management and care of woodland, etc., and gives information on various subjects of Agricultural Science, for the use and advantage of the citizens of Connecticut.

The station does not make sanitary analyses of water, as that work has been undertaken by the State Board of Health.

The station makes analyses of fertilizers, feeds and other products, tests seeds, etc., for the citizens of Connecticut, without charge, provided—

1. That the results are of use to the public and are free to publish.
2. That the samples are taken from stock now in the market, and in accordance with the station "Instructions for Sampling."
3. That the samples are fully described and retail prices given on the station "Forms of Description."
4. That it is physically possible for the station to do the work in a reasonable time.

Results of analysis or investigation that are of general interest are published in bulletins, of which copies are sent to each Post Office in this state, and to every citizen of the state who applies for them. These results are summed up in the annual reports made to the Governor.

It is the wish of the Board of Control to make the station as widely useful as its resources will admit. Every Connecticut citizen who is concerned in agriculture, whether farmer, manufacturer, or dealer, has the right to apply to the station for any assistance that comes within its province to render, and the station will respond to all applications as far as lies in its power.

Instructions and Forms for taking samples sent on application.

Parcels by express should be prepaid and marked with the name of the sender. Communications should be directed to the

AGRICULTURAL EXPERIMENT STATION,
NEW HAVEN, CONN.

The station grounds, laboratories and office are at 123 Huntington street, between Whitney avenue and Prospect street, 1⅝ miles north of City Hall. Huntington street may be reached by Whitney avenue electric cars, which pass the railway station every twelve minutes.

The station has Telephone connection and may be spoken from all parts of the State at all hours between 7.30 A. M. and 9.30 P. M.

VISITORS ARE ALWAYS WELCOME.

REPORT OF THE BOARD OF CONTROL

OF THE

CONNECTICUT AGRICULTURAL EXPERIMENT STATION.

To His Excellency, Abiram Chamberlain, Governor of Connecticut:

The Board of Control of the Connecticut Agricultural Experiment Station herewith respectfully submits its report for the year ending October 31, 1903:

During the year there have been no changes in the station staff nor in the lines of work carried on.

In April, May and June the sampling agent, Mr. Churchill, visited eighty-two towns and villages in all parts of the state, and drew for analysis five hundred and sixty-two samples of commercial fertilizers, which represented all but one of the brands which have been entered for sale this year in Connecticut. Of these and other samples of fertilizers and manurial waste products four hundred and eighty-eight analyses have been made by Messrs. Winton, Ogden, Silverman and Bailey, with the assistance of Mr. Lange. The detailed account of the results of this work has been prepared for publication by the director, in a pamphlet of about 100 pages, which is now in the printers' hands and is Part I of the Report of the Station Staff.

During the year covered by the report on food products, ending July 31, samples have been purchased in fifteen towns and villages of the state, and two hundred and nineteen of them have been examined. Thirty samples have also been examined at the request of purchasers, or of health boards. For the dairy commissioner there have been examined four hundred and forty-four samples of vinegar, four hundred and seventeen of molasses and five of butter. The total number of examinations of food products has been about eleven hundred and twenty-three. The results of this work are now being prepared for publication.

During the last month the sampling agent has visited forty-nine towns and villages and has gathered two hundred and ninety samples of commercial feeds, which are now being analyzed. The results of these analyses will be published in bulletin form at the earliest possible moment.

Mr. Winton has done all the microscopic work involved in the examinations above referred to, and the chemical work has been done by him, with the help of Messrs. Ogden, Silverman and Bailey.

Under the statute concerning the testing of Babcock apparatus, the station has examined for dairymen and others, and marked as accurate or bad, two hundred and ninety pieces of glass apparatus—pipettes and milk and cream test bottles.

One hundred and forty-four samples of field and garden seeds have been tested as to their vitality, in the interest of seed growers and purchasers, by Mr. Churchill.

Dr. Osborne, with the assistance of Mr. Harris, has continued his investigations on the vegetable proteins.

The entomologist of the station, Dr. Britton, who is also state entomologist, has officially inspected forty-seven nurseries and made twenty-six examinations of orchards, gardens, etc. In two cases he has served notices on fruit growers, ordering the spraying or destruction of trees which were, in his opinion, a menace to the surrounding orchards of other owners.

Experiments on the best means of destroying the San José scale-insect have been made in four localities, and under the supervision of the entomologist and his assistant, 115,000 trees have been sprayed by their owners.

A beginning has been made of observations regarding the mosquito in this state, with a view to lessening this nuisance.

Important additions have been made to the entomological collections and exhibit sets of various injurious species. These, with the common insecticides, have been shown at the annual meeting of the State Board of Agriculture, at Norwich, in December; the annual meeting of the Connecticut Pomological Society, at Hartford, in February, and at the fruit exhibit of the Pomological Society at Berlin, in September.

One hundred and eighty-eight specimens of insects have been sent to the station by farmers and others, for identification. These were determined, when possible, and information regarding their habits and life history and the best ways of exterminating them has been mailed to the sender in all cases.

Eight hundred and twenty-eight letters have been written on the work of this department, and entomological addresses and illustrated lectures given at fifteen agricultural meetings.

Dr. Clinton, the station botanist, has made a careful botanical survey of the state, to determine what are the fungous diseases of our crops and what damage they do, and to secure specimens of all of them, for future reference or study. To the four hundred and fifty specimens of economic fungi from Connecticut previously collected by others, Dr. Clinton has added more than one thousand, and the fungi in the station's collection now number over 10,600. Two common diseases, the potato blight and the melon blight, have been studied, both in the laboratory and in the field, and a number of spraying experiments have been made on each.

Being delegated by the State Botanical Society to study and list the fungi of the state, Dr. Clinton has also collected many species not strictly of economic importance. Thus, to the dozen species of smuts previously known in the state, Dr. Clinton has added one hundred and thirteen. He is also engaged on the final part of an extended monograph on the group Ustilagineæ, or the smuts.

Dr. Clinton has also attended most of the field meetings and institutes of the Pomological Society, has made numerous addresses on matters in his line of work and has also made exhibits showing the appearance of the most important fungous diseases of crops.

The forester, Mr. Mulford, has made a considerable number of experimental plantations on the station forest tract, in Windsor, involving the seeding with tree seeds of about eleven acres, setting thirty-nine hundred cuttings and planting sixty-seven thousand seedling trees. He has purchased a site of about eight hundred acres for a state forest, at a cost of about thirteen hundred dollars. He has also made a field study and furnished plans to the Middletown Board of Water Commissioners, for treating woodland on their watershed, and has given help to private owners of woodland, whenever it was requested.

The field experiment on tobacco this year has chiefly concerned the selection of seed from plants which bore leaves of the most desirable size and shape, and on which the flowers were protected from any chance of cross-fertilization.

The field experiment on the fertilization of peach orchards has been continued, this being the seventh year of its progress.

At the January session, 1903, the General Assembly passed an Act which provided for the printing of 12,000 copies of the report of this station, a number which, at present, makes it possible to supply those on our mailing list and to reserve a few hundred to meet occasional requests.

The twenty-sixth report of this Station, a volume of 492 pages, containing 15 full page plates and 78 other illustrations, has been issued and distributed in an edition of 12,000 copies.

The following bulletins have been issued during the year, the earlier ones in editions of 10,500, the later ones in editions of 12,000 copies: Bulletin 141, January, 1903, 60 pages, Commercial Feeding Stuffs in the Connecticut Market; Bulletin 142, January, 1903, A Spray Calendar; Bulletin 143, May, 1903, 10 pages and 2 plates, Two Common Scale-Insects of the Orchard; Bulletin 144, October, 1903, 26 pages, 3 plates, Fighting the San José Scale-Insect in 1903.

More than 4,800 letters and manuscript reports of fertilizer and other analyses have been written on station business within the year.

Some twenty-five addresses have been made by members of the staff at agricultural gatherings, often illustrated with stereopticon views and exhibits of various kinds, and three formal exhibits of insect and fungous pests, and the methods of combating both have been made, in connection with the annual meeting of the Board of Agriculture, and of the Pomological Society and at the Pomological Society's exhibit at Berlin.

The Board of Control has held four meetings during the year—on December 2, 1902, and January 20, April 18 and June 9, 1903.

All of which is respectfully submitted.

(Signed) William H. Brewer, *Secretary.*

New Haven, October 31, 1903.

REPORT OF THE TREASURER.

E. H. Jenkins, in account with the Connecticut Agricultural Experiment Station for the fiscal year ending September 30, 1903.

Receipts.

State Appropriation, Agriculture	$10,000.00	
State Appropriation, Foods	2,500.00	
State Appropriation, Insect Pests	3,000.00	
United States Treasurer	7,500.00	
Analysis Fees	2,190.00	
Sale of Tobacco	61.97	
Miscellaneous Receipts	202.18	
From the Lockwood Estate	8,594.03	
		$34,048.18

Disbursements.

E. H. Jenkins, Salary	$2,800.00
W. H. Brewer, "	100.00
V. E. Cole, "	800.00
L. M. Brautlecht, "	540.00
A. L. Winton, "	2,000.00
T. B. Osborne, "	1,800.00
A. W. Ogden, "	1,700.00
I. F. Harris, "	900.00
Max Silverman, "	750.00
E. M. Bailey, "	535.13
W. E. Britton, "	1,500.00
G. P. Clinton, "	2,000.00
Walter Mulford, "	1,174.99
J. B. Olcott, "	800.00
H. Lange, "	740.00
Wm. Veitch, "	580.00
V. L. Churchill, "	660.00
Labor	1,511.35
Publications	1,146.59
Postage	164.63
Stationery	81.04
Telephone and Telegraph	85.00
Freight and Express	96.86
Gas and Kerosene	264.31
Coal	638.40
Water	175.62

Chemicals and Laboratory Supplies	1,011.54	
Agricultural and Horticultural Supplies	134.96	
Miscellaneous Supplies	193.87	
Fertilizers	114.19	
Feeding Stuffs	104.03	
Library and Periodicals	1,084.24	
Tools and Machinery	79.30	
Furniture and Fixtures	173.47	
Scientific Apparatus	305.97	
Traveling by the Board	88.44	
Traveling by the Staff	364.58	
Tobacco Experiment	377.60	
Fertilizer Sampling	175.87	
Food Sampling	268.78	
Insect Pest Appropriation to State Entomologist	2,114.76	
Contingent	180.56	
Lockwood Expenses and Forestry	1,940.56	
Betterments	236.65	
Repairs	524.03	
		$33,017.32
Analysis Fees on hand Sept. 30, 1903		145.62
Insect Pest Funds on hand Sept. 30, 1903		885.24
		$34,048.18

COMMERCIAL FERTILIZERS.

DUTIES OF MANUFACTURERS AND DEALERS.

The General Statutes of Connecticut, sections 4581 to 4590, inclusive, make the following requirements regarding all commercial fertilizers "except stable manure, and the products of local manufacturers of less value than ten dollars per ton":

1. The seller is responsible for affixing to every package sold, a label which shall correctly give the number of pounds in the package, name of the fertilizer, name and address of manufacturer, place of manufacture and a statement of composition, expressed in a way approved by this Station.

2. He is also responsible for the payment to the Station director, on or before May first, annually, of an analysis fee on every brand sold by him.

3. Before any brand of fertilizer is sold in the state, the local agent or seller must file with the director of this Station two certified copies of the statement named in 1, and a sealed glass jar containing not less than one pound of the fertilizer with an affidavit that it is a fair average sample.

The local agent or seller is, however, free from the three obligations just stated if the manufacturer or importer fulfils them instead.

4. In any case the local agent or seller must annually report to the director of this station his name, residence, address and the names of the fertilizers which he sells, with the names and addresses of the manufacturers or importers.

Copies of the statutes regarding fertilizers will be sent on application.

The analysis fee for any brand will usually be ten, twenty or thirty dollars, according as one, two, or all three of the ingredients—nitrogen, phosphoric acid and potash—are contained or claimed to exist in the fertilizer.

The statement of composition referred to in the statute must conform to the following requirements, which are approved by this Station:—

A statement of the percentages of Nitrogen, Phosphoric Acid (P_2O_5) and Potash (K_2O), and of their several states or forms, will suffice in most cases. Other ingredients may be named if desired.

In all cases the percentage of *nitrogen* must be stated. Ammonia may also be given when actually present in ammonia salts, and "ammonia equivalent of nitrogen" may likewise be stated.

The percentages of soluble and reverted phosphoric acid may be given separately or together, and the term "available" may be used in addition to, but not instead of, soluble and reverted.

The percentage of insoluble phosphoric acid may be stated or omitted.

In case of bone, fish, tankage, dried meat, dried blood, etc., the statement of chemical composition may take account of the two ingredients, Nitrogen and Phosphoric Acid.

For potash salts the percentage of Potash (potassium oxide) should always be given: that of sulphate of potash or muriate of potash may also be stated.

OBSERVANCE OF THE FERTILIZER LAW.

During 1903 thirty-four individuals or firms have entered for sale in this state two hundred and thirty-seven brands of fertilizers, viz.:

Special manures for particular crops	107
Other nitrogenous superphosphates	80
Bone manures and "bone and potash"	28
Fish, tankage, castor pomace and chemicals	22
Total	237

Here follows a list of manufacturers who have paid analysis fees as required by the fertilizer law and the names or brands of the fertilizers for which fees have been thus paid for the year ending May 1st, 1904:

Firm.	*Brand of Fertilizer.*
American Agricultural Chemical Co., The, 26 Broadway, N. Y. City.	Bradley's Complete Manure for Potatoes and Vegetables,
	Bradley's Superphosphate,
	" Potato Manure,
	" Potato Fertilizer,
	" Corn Phosphate,
	" Farmers' New Method Fertilizer,
	" Eclipse Phosphate,
	" Complete Manure for Top Dressing Grass and Grain,
	" Niagara Phosphate,
	Church's Fish and Potash,
	Crocker's Potato, Hop and Tobacco Phosphate,
	" Ammoniated Corn Phosphate,
	" New Rival Fertilizer,

Firm.	*Brand of Fertilizer.*
American Agricultural Chemical Co., The,—*Continued.*	Darling's Farm Favorite,
	“ Potato Manure,
	“ Dissolved Bone and Potash,
	“ Tobacco Grower,
	“ Blood, Bone and Potash,
	“ General Fertilizer,
	East India Complete Potato Manure,
	“ A. A. Ammoniated Superphosphate,
	Great Eastern Northern Corn Special,
	“ Vegetable, Vine and Tobacco,
	“ General Fertilizer,
	“ Grass and Oats Fertilizer,
	“ Garden Special,
	Packers' Union Gardeners' Complete Manure,
	“ Animal Corn Fertilizer,
	“ Potato Manure,
	“ Universal Fertilizer,
	“ Wheat, Oats and Clover Fertilizer,
	Quinnipiac Market Garden Manure,
	“ Phosphate,
	“ Potato Manure,
	“ Potato Phosphate,
	“ Corn Manure,
	“ Climax,
	Read's Practical Potato Special,
	“ Standard Superphosphate,
	“ Vegetable and Vine Fertilizer,
	Wheeler's Corn Fertilizer,
	“ Potato Manure,
	“ Havana Tobacco Grower,
	“ Superior Truck Fertilizer,
	“ Bermuda Onion Grower,
	“ Grass and Oats Fertilizer,
	Williams & Clark's High Grade Special,
	“ “ Americus Ammoniated Bone Superphosphate,
	“ “ Potato Phosphate,
	“ “ Americus Potato Manure,
	“ “ Americus Corn Phosphate,
	The A. A. C. Co.'s H. G. Tobacco Manure,
	“ “ Complete Tobacco Manure,
	“ “ Southport XX Special,
	Complete Manure with 10% Potash,
	Grass and Lawn Top Dressing,
	Castor Pomace,
	Tobacco Starter and Grower,
	Dry Ground Fish,
	Fine Ground Bone,
	Nitrate of Soda,
	Muriate of Potash.

Firm.	*Brand of Fertilizer.*
American Farmers' Fertilizer Co., 133-137 Front St., N. Y. City.	American Farmers' Market Garden Special, " " Complete Potato, " " Corn King, " " Ammoniated Bone, " " Grain Grower.
Armour Fertilizer Works, The, Baltimore, Md.	Grain Grower, Bone, Blood and Potash, High Grade Potato, All Soluble, Ammoniated Bone with Potash, Bone Meal.
Berkshire Fertilizer Co., Bridgeport, Conn.	Berkshire Complete Fertilizer, " Potato and Vegetable Phosphate, " Ammoniated Bone Phosphate, " Fine Ground Bone.
Boardman, F. E., Route 1, Middletown, Conn.	Boardman's Complete Fertilizer for Potatoes and General Crops.
Bohl, Valentine, Waterbury, Conn.	Self-Recommending Fertilizer.
Bowker Fertilizer Co., 68 Broad St., N. Y. City.	Stockbridge Special Corn Manure, " Potato and Vegetable Manure, " Grass Top Dressing, Potato and Vegetable Fertilizer, Potato and Vegetable Phosphate, Hill and Drill Phosphate, Farm and Garden Phosphate, or Ammoniated Bone, Fisherman's Brand Fish and Potash, Tobacco Starter, Tobacco Ash Elements, Complete Alkaline Tobacco Grower, Sure Crop Phosphate, Market Garden Fertilizer, Corn Phosphate, Early Potato Manure, Fine Ground Dry Fish, Fairfield Onion Fertilizer, 25% Ash Compound, Nitrate of Soda, Muriate of Potash, Fresh Ground Bone, Canada Hard Wood Ashes, Acid Phosphate, Square Brand Bone and Potash, Castor Pomace, Gloucester Fish and Potash, Middlesex Special.
Coe, E. Frank, Co., 133-137 Front St., N. Y. City.	E. Frank Coe's Ground Bone, " H. G. Ammoniated Bone Superphosphate, " Fish and Potash (FP), " Gold Brand Excelsior Guano,

Firm.	*Brand of Fertilizer.*
Coe, E. Frank, Co., 133-137 Front St., N. Y. City—*Continued.*	E. Frank Coe's Red Brand Excelsior Guano, “ Long Islander Market Garden Special, “ Columbian Corn, “ Columbian Potato, “ Special Potato Manure.
Connecticut Valley Orchard Co., The, Berlin, Conn.	C. V. O. Co.'s Complete High Grade Fertilizer.
Cooper's Glue Factory, Peter, 17 Burling Slip, N. Y. City.	Pure Bone-Dust.
Dennis, E. C., Stafford Springs, Conn.	Ground Bone.
Downs & Griffin, Derby, Conn.	Ground Bone.
Ellsworth, F., Hartford, Conn.	Shoemaker's Swift Sure Superphosphate for General Use, “ “ Bone Meal, “ “ Superphosphate for Potatoes.
Frisbie, L. T., Co., The, Hartford, Conn.	Bone Meal.
James, Ernest L., Warrenville, Conn.	James' Bone Phosphate, “ Ground Bone.
Joynt, John, Lucknow, Ontario.	Canada Hard Wood Ashes.
Kelsey, E. R., Branford, Conn.	Bone, Fish and Potash.
Lister's Agricultural Chemical Works, Newark, N. J.	Lister's Potato Manure, “ Pure Raw Bone Meal, “ Special 10% Potato, “ Success Fertilizer, “ Standard Superphosphate of Lime, “ Special Corn and Potato, “ Animal Bone and Potash.
Lowell Fertilizer Co., *see Swift's Lowell Fertilizer Co.*	
Ludlam, Frederick, 108 Water St., N. Y. City.	“Cecrops” or Dragon's Tooth, Cereal Brand of Cecrops Fertilizer.
MacCormack, Wm., Wolcott, Conn.	Mad River Strictly Pure Ground Bone.
Manchester. E. & Sons, Station A, Winsted, Conn.	Manchester's Formula.
Mapes F. & P. G. Co., The, 143 Liberty St., N. Y. City.	Potato Manure, Tobacco Starter, Improved, Tobacco Manure, Wrapper Brand, Fruit and Vine Manure, Economical Potato Manure, Vegetable Manure, or Complete Manure for Light Soils,

Firm.	*Brand of Fertilizer.*
Mapes F. & P. G. Co., The, 143 Liberty St., N. Y. City—*Continued.*	Average Soil Complete Manure,
	Corn Manure,
	Top Dresser, Improved, Half Strength,
	Complete Manure ("A" Brand),
	Dissolved Bone,
	Cereal Brand,
	Seeding Down Manure,
	Tobacco Ash Constituents,
	Improved Top Dresser, Full Strength.
Nassau Fertilizer Co., 5 Beaver St., N. Y. City.	Gladiator Truck and Potato,
	Nassau Practical.
National Fertilizer Co., Bridgeport, Conn.	Chittenden's Market Garden Manure,
	" Complete,
	" Potato Phosphate,
	" Ammoniated Bone,
	" Fine Ground Bone,
	" Universal Phosphate,
	" Fish and Potash,
	" H. G. Special Tobacco Manure,
	" Complete Tobacco Fertilizer.
Ohio Farmers Fertilizer Co., The, Columbus, Ohio.	General Crop Fish Guano,
	Ammoniated Bone and Potash,
	Potato and Tobacco Special.
Olds & Whipple, Hartford, Conn.	Complete Tobacco Fertilizer,
	Vegetable Potash,
	Special Phosphate,
	Potato Fertilizer.
Rogers & Hubbard Co., The, Middletown, Conn.	Hubbard's Fertilizer for Oats and Top Dressing,
	" '02 Top-Dress Phosphate,
	" Grass and Grain Fertilizer,
	" Soluble Corn Manure,
	" Soluble Potato Manure,
	" Soluble Tobacco Manure,
	" All Soils and All Crops Phosphate,
	" Corn Phosphate,
	" Potato Phosphate,
	" Raw Knuckle Bone Flour,
	" Strictly Pure Fine Bone.
Rogers Mfg. Co., The, Rock Fall, Conn.	All Round Fertilizer,
	Complete Potato and Vegetable,
	Complete Corn and Onion,
	Fish and Potash,
	Soluble Tobacco and Potato,
	Oat and Top Dressing,
	Grass and Grain for Seeding Down,
	Soluble Tobacco Fertilizer,
	Pure Ground Bone.
Russia Cement Co., Gloucester, Mass.	Essex XXX Fish and Potash,
	" Corn Fertilizer,

Firm.	*Brand of Fertilizer.*
Russia Cement Co., Gloucester, Mass.—*Continued.*	Essex Market Garden and Potato Manure,
	“ A1 Superphosphate,
	“ Complete Manure for Corn, Grain and Grass,
	“ Complete Manure for Potatoes, Roots and Vegetables,
	“ Tobacco Starter,
	“ Special Tobacco Manure,
	“ Odorless Lawn Dressing,
	“ Dry Ground Fish,
	“ Fine Bone Meal.
Sanderson Fertilizer & Chemical Co., New Haven, Conn.	Sanderson's Formula A,
	“ Formula B for Tobacco,
	“ Corn Superphosphate,
	“ Potato Manure,
	“ Blood, Bone and Meat,
	“ Fine Ground Bone,
	“ Special with 10% Potash,
	“ Plain Superphosphate,
	Luce Bros.' Bone, Fish and Potash,
	Nitrate of Soda,
	Muriate of Potash,
	Double Sulphate of Potash.
Shay, C. M., Groton, Conn.	Mystic Gild Edge Potato Manure,
	Pure Ground Bone,
	Corn Manure.
Shoemaker, M. L. & Co., *see Ellsworth, F.*	
Swift's Lowell Fertilizer Co., 44 No. Market St., Boston.	Swift's Lowell Potato Phosphate,
	“ Potato Manure,
	“ Bone Fertilizer,
	“ Animal Brand,
	“ Dissolved Bone and Potash,
	“ Ground Bone,
	“ Market Garden Manure,
	“ Perfect Tobacco Grower.
Wilcox Fertilizer Works, Mystic, Conn.	Wilcox's Potato, Onion and Tobacco Manure,
	“ Potato Manure,
	“ Complete Bone Superphosphate,
	“ Special Superphosphate,
	“ High Grade Fish and Potash,
	“ Fish and Potash,
	“ Grass Fertilizer,
	“ Dry Ground Fish,
	“ Pure Ground Bone,
	“ Nitrate of Soda,
	“ Acid Phosphate,
	“ Muriate of Potash.
Woodruff, S. D. & Sons, Orange, Conn.	Home Mixed Fertilizer.

DUTIES OF THE STATION.

The Station is authorized to take samples from any lot of fertilizer in the possession of any dealer and is required to make and publish yearly one or more analyses of each fertilizer.

These analyses are chiefly useful as a guide in making purchases for the following year. Most of them are of brands which are offered year after year in Connecticut and the analyses serve to show whether these brands are maintaining their original quality.

The year's supply of fertilizers is for the most part shipped into the state just before planting time, much of it after river navigation is opened. Our agent finds that many brands are not in market till the middle of April. Obviously these trade conditions make it absolutely impossible for the Station to sample and analyze the two hundred and thirty brands of fertilizers sold in Connecticut and tabulate and publish the results in time to show the composition of all of them before they are bought and applied.

But when new brands are offered, or firms which have not previously done business here enter new brands of fertilizers, the Station endeavors to analyze such brands at once and to distribute the report of the results as quickly and widely as possible. Farmers can aid greatly by calling the attention of the Station promptly to new kinds of fertilizers or of cattle foods which are offered.

SAMPLING AND COLLECTION OF FERTILIZERS.

During March, April and May, Mr. V. L. Churchill, the sampling agent of this Station, visited eighty-two towns and villages in Connecticut to draw samples of commercial fertilizers for analysis. These places were distributed as follows:

Litchfield County	5
Hartford County	23
Tolland County	6
Windham County	10
New London County	9
Middlesex County	6
New Haven County	15
Fairfield County	8
	82

In these places five hundred and sixty-two samples were taken, representing all but one of the brands which have been entered for sale in this state.

The sampling agent could not find Lister's Potato Manure on sale and no sample was deposited by the manufacturer at the Station. It was, therefore, impossible to make an analysis of it as provided by the fertilizer law.

With this exception an analysis has been made of every brand of fertilizer which has been entered at the Station for sale in Connecticut.

When several samples of a single brand are drawn in different parts of the state, the analysis is usually performed, not on any single sample, but on a mixture made of equal weights of all of the several samples. Thus, it is believed, the average composition of the goods is more fairly represented than by the analysis of single samples.

The Station agent is instructed in every case to open at least three packages of each brand for sampling, and, if the number of packages is very large, to take a portion from every tenth one, by means of a sampling tube which withdraws a section or core through the entire length of the bag or barrel.

As a rule, the Station will not analyze samples taken—

1. From dealer's stock of less than one ton.
2. From stock which has lain over from last season.
3. From stock which evidently is improperly stored, as in bags lying on wet ground, or exposed to the weather, etc.

The Station desires the coöperation of farmers, farmers' clubs and granges in calling attention to new brands of fertilizers, and in securing samples of all goods offered for sale. *All samples must be drawn in strict accordance with the Station's Instructions for Sampling, and must also be properly certified,* if the Station analysis is desired. A copy of these instructions and blank certificates will be sent on application.

ANALYSES OF FERTILIZERS.

During the year 489 samples of commercial fertilizers and manurial waste-product have been analyzed. A classified list of them is given on page 17 and the results of their examination are given in detail in the following pages.

Samples are analyzed as promptly as possible in the order in which they are received. As soon as an analysis is completed, a copy of it is sent to the party who furnished the sample, and also to the manufacturer, in order that there may be opportunity for correction or protest, before the results are published.

The following "Explanations" are intended to embody the principles and data upon which the valuation of fertilizers is based, a knowledge of which is essential to a correct understanding of the analyses that are given on subsequent pages:

EXPLANATIONS CONCERNING THE ANALYSIS OF FERTILIZERS AND THE VALUATION OF THEIR ACTIVE INGREDIENTS.

The Elements of Fertilizers.

The three chemical elements whose compounds chiefly give value, both commercial and agricultural, to commercial fertilizers, are Nitrogen, Phosphorus and Potassium. The other elements found in fertilizers, viz.: Sodium, Calcium, Magnesium, Iron, Silicon, Sulphur, Chlorine, Carbon, Hydrogen and Oxygen, which are necessary or advantageous to the growth of vegetation, are either so abundant in the soil or may be so cheaply supplied to crops, that they do not considerably affect either the value or cost of high-priced commercial fertilizers.

Nitrogen in fertilizers is, on the whole, the least abundant of their valuable elements, and is their most costly ingredient.

Free Nitrogen is universally abundant, making up nearly four-fifths of the common air, and appears to be directly assimilable by various low vegetable organisms, and with aid of certain bacteria, by leguminous plants (the clovers, alfalfa, peas, beans, lentils, esparsette, lupins, vetches, lathyrus, peanut, yellow locust, honey locust, etc.), and by a few non-leguminous plants, carrying root nodules, viz.: the Oleasters (*Eleagnus*), the Alders (*Alnus*), and a single family of coniferous trees (*Podocarpus*), but not at all, according to present evidence, by the cereals or other field and garden crops.

Organic Nitrogen is the nitrogen of animal and vegetable matters which is chemically united to carbon, hydrogen and oxygen. Some forms of organic nitrogen, as those of blood, flesh and seeds, are highly active as fertilizers; others, as found in leather and peat, are comparatively slow in their effect on vegetation, unless these matters are chemically disintegrated. Since organic nitrogen may often readily take the form of ammonia, it has been termed ***potential ammonia.***

Ammonia (NH_3) ***and Nitric Acid*** (N_2O_5) are results of the chemical change of ***organic nitrogen*** in the soil and manure heap, and contain nitrogen in its most active forms. They occur in commerce—the former in sulphate of ammonia, the latter in nitrate of soda; 17 parts of ammonia, or 66 parts of pure sulphate of ammonia, contain 14 parts of nitrogen: 85 parts of pure nitrate of soda also contain 14 parts of nitrogen.

Phosphorus is found in fertilizers in the form of phosphates, usually those of calcium, iron and aluminum, or, in case of "superphosphates," to some extent, in the form of free phosphoric acid.

Water-soluble Phosphoric Acid is phosphoric acid (or a phosphate) that freely dissolves in water. It is the characteristic ingredient of superphosphates, in which it is produced by acting on "insoluble" (or "citrate-soluble") phosphates, with diluted sulphuric acid. Once well incorporated with the soil, it "reverts" and becomes insoluble, or very slightly soluble, in water.

Citrate-soluble Phosphoric Acid signifies the phosphoric acid (of various phosphates) that is freely taken up by a hot, strong solution of neutral ammonium citrate, which solution is, therefore, used in analysis to determine its quantity. The designation *citrate-soluble* is synonymous with the less explicit terms, *reverted, reduced,* and *precipitated,* all of which imply phosphoric acid that was once easily soluble in water, but from chemical change has become insoluble in that liquid.

Water-soluble and citrate-soluble phosphoric acid are, probably, about equally valuable as plant food, and of nearly equal commercial value. In some cases, indeed, the water-soluble gives better results on crops; in others, the "reverted" is superior. In most instances there is little to choose between them.

Insoluble Phosphoric Acid implies various phosphates insoluble both in water and in hot solution of neutral ammonium citrate. The phosphoric acid of Canadian "Apatite," of South Carolina and Florida "Rock phosphate," and of similar dense mineral phosphates, as well as that of "bone ash" and "bone black," is mostly insoluble in this sense, and in the majority of cases gives no visible good results when these substances, in the usual ground state, are applied to crops. They contain, however, a small proportion of citrate-soluble phosphoric acid, and sometimes, when they are reduced to extremely fine dust (floats) or applied in large quantities, especially on "sour soils," or in conjunction with abundance of decaying vegetable matter (humus), they operate as efficient fertilizers.

Available Phosphoric Acid is an expression properly employed, in general, to signify phosphoric acid in any form, or phosphates of any kind that serve to nourish vegetation. In the soil, phosphoric acid and all phosphates, whatever their solubilities, as defined in the foregoing paragraphs, are more or less freely and extensively available to growing plants. Great abundance of "insoluble" phosphoric acid may serve crops equally well with great solubility of a small supply, especially when the soil and the crop carry with them conditions highly favorable to the assimilation of plant food.

In commercial fertilizers, "available phosphoric acid" is frequently understood to be the sum total of the "water-soluble" and the "citrate-soluble," with the exclusion of the "insoluble."

The "insoluble phosphoric acid" in a commercial fertilizer costing $20 to $45 per ton has very little or no value to the purchaser, because the quantity of it which can commonly be put on an acre of land has no perceptible effect upon the crop and because its presence in the fertilizer excludes an equal percentage of more needful and much more valuable ingredients.

In raw bone much of the phosphoric acid (calcium phosphate) is insoluble, because of the animal matter of the bones which envelopes it; but when the animal matter decays in the soil, or when it is disintegrated by boiling or steaming, the phosphate mostly remains in an available form. In some soils the phosphoric acid of "Basic-Slag" and of "Grand Cayman's Phosphate" is as freely taken up by crops as water-soluble phosphoric acid, but in other soils is much less available than the latter.

Phosphoric acid in all the Station analyses is reckoned as "anhydrous phosphoric acid" (P_2O_5), also termed among chemists phosphoric anhydride, phosphoric oxide and phosphorus pentoxide.

POTASSIUM exists in plants, soils and fertilizers in the form of various salts, such as chloride (muriate), sulphate, carbonate, nitrate, silicate, etc. Potassium itself is scarcely known except as a chemical curiosity.

Potash signifies the substance known in chemistry as potassium oxide (K_2O), which is reckoned as the valuable fertilizing ingredient of "potashes" and "potash salts." In these it should be freely soluble in water and is most costly in the form of carbonate, and cheapest in the form of muriate (potassium chloride). In unleached ashes of wood and cotton-seed hulls it exists mainly as potassium carbonate.

VALUATION OF FERTILIZERS.

The valuation of a fertilizer, as practiced at this Station, consists in calculating the retail trade-value or cash-cost at freight centers (in raw material of good quality) of an amount of nitrogen, phosphoric acid and potash equal to that contained in one ton of the fertilizer.

Plaster, lime, stable manure and nearly all of the less expensive fertilizers have variable prices, which bear no close relation to their chemical composition, but guanos, superphosphates and similar articles, for which $20 to $45 per ton are paid, depend for their trade-value exclusively on the substances, nitrogen, phosphoric acid and potash, which are comparatively costly and steady in price. The trade-value per pound of these ingredients is reckoned from the current market prices of the standard articles which furnish them to commerce.

The consumer, in estimating the reasonable price to pay for high-grade fertilizers, should add to the trade-value of the above-named ingredients a suitable margin for the expenses of manufacture and sale, and for the convenience or other advantage incidental to their use.

TRADE-VALUES OF FERTILIZER ELEMENTS FOR 1903.*

The average trade-values or retail costs in market, per pound, of the ordinarily occurring forms of nitrogen, phosphoric acid and potash in raw materials and chemicals, as found in New England, New York and New Jersey markets during 1902, were as follows:

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* Adopted at a conference of representatives of the Connecticut, Massachusetts, New Jersey and Rhode Island stations held in March, 1903.

	Cents per pound.
Nitrogen in nitrates	15
in ammonia salts	17½
Organic nitrogen, in dry and fine-ground fish, meat and blood, and in mixed fertilizers	17
in fine* bone and tankage	16½
in coarse* bone and tankage	12
Phosphoric acid, water-soluble	4½
citrate-soluble†	4
of fine* ground bone, and tankage	4
of coarse* bone and tankage	3
of cotton-seed meal, castor pomace, and ashes...	4
of mixed fertilizers, if insoluble in ammonium citrate†	2
Potash as high-grade sulphate in forms free from muriate (or chlorides)	5
as muriate	4¼

The foregoing are, as nearly as can be estimated, the prices at which, during the six months preceding March last, the respective ingredients were retailed for cash, in our large markets, in those raw materials which are the regular source of supply. The valuations obtained by use of the above figures will be found to correspond fairly with the average retail prices, at the large markets, of standard raw materials, such as the following:

Sulphate of Ammonia,
Nitrate of Soda,
Dried Blood,
Azotin,
Ammonite,
Muriate of Potash,
Sulphate of Potash,
Plain Superphosphate,
Dry Ground Fish,
Bone and Tankage,
Ground South Carolina Rock.

Valuation of Superphosphates, Special Manures and Mixed Fertilizers of High Grade.

The Organic Nitrogen in these classes of goods is reckoned at the price of nitrogen in raw materials of the best quality,‡ 16½ cents.

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* In this report "fine," as applied to bone and tankage, signifies smaller than $^1/_{50}$ inch; and "coarse," larger than $^1/_{50}$ inch.

† Dissolved from 2 grams of the fertilizer, previously extracted with pure water, by 100 cc. neutral solution of ammonium citrate, sp. gr. 1.09, in thirty minutes, at 65° C., with agitation once in five minutes. Commonly called "reverted" or "backgone" Phosphoric Acid.

‡ This concession gives a dishonest manufacturer the opportunity to defraud the consumer, by "working off" inferior or almost worthless leather, bat guano, and similar materials which "analyze well," containing up to 8 or 9 per cent. of nitrogen, much or all of which may be quite inert; provided this inferiority is not discovered by the chemical examination. But since honest and capable manufacturers generally claim to use only "materials of the best quality," it would be unjust

Insoluble Phosphoric Acid is reckoned at 2 cents per pound. Potash is rated at 4¼ cents, if sufficient chlorine is present in the fertilizer to combine with it to make muriate. If there is more Potash present than will combine with the chlorine, then this excess of Potash is reckoned at 5 cents per pound.

In most cases the valuation of the ingredients in superphosphates and specials falls below the retail price of these goods. The difference between the two figures represents the manufacturers' charge for converting raw materials into manufactured articles and selling them. The charges are for grinding and mixing, bagging or barreling, storage and transportation, commission to agents and dealers, long credits, interest on investments, bad debts and, finally, profits.

The majority of the manufacturers agree that the average cost of mixing, bagging, handling and cartage ranges from $3 to $4.50 per ton.

In 1903 the average selling price of Ammoniated Superphosphates and Guanos was $30.39 per ton, the average valuation was $21.10, and the difference $9.29, an advance of 44 per cent. on the valuation and on the wholesale cost of the fertilizing elements in the raw materials.

In case of special manures the average cost was $33.30, the average valuation $23.53 and the difference $9.77 or 41.5 per cent. advance on the valuation.

To obtain the Valuation of a Fertilizer we multiply the pounds per ton of nitrogen, etc., by the trade-value per pound. We thus get the values per ton of the several ingredients, and adding them together we obtain the total valuation per ton.

In case of *Ground Bone and Tankage,* the sample is sifted into the two grades just specified (see foot note, page 14), and we separately compute the nitrogen-value of each grade by multiplying the pounds of nitrogen per ton by the per cent. of each grade, multiplying one-tenth of that product by the trade-value per pound of nitrogen in that grade, and taking this final product as the result in cents. Summing up the separate values of each grade thus obtained, together with the values of each grade of phosphoric acid, similarly computed, the total is the valuation of the sample of bone.

USES AND LIMITATIONS OF FERTILIZER VALUATION.

The uses of the "Valuation" are two-fold:

1. To show whether a given lot or brand of fertilizer is probably worth, as a commodity of trade, what it costs. If the selling price is not higher than the valuation, the purchaser may be tolerably sure that the

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to them to assume that their fertilizers contain anything inferior. Farmers should satisfy themselves that they are dealing only with honest and with intelligent manufacturers. This can be done at little cost by such coöperation as Farmers' Clubs and Granges may practice, sending a competent and trusty agent to visit factories frequently and unexpectedly and to take samples of raw materials. Honorable manufacturers will be glad to show all their raw materials and processes to their customers, especially if such inspection is insisted on as a preliminary to business. Coöperation may thus insure satisfactory quality of goods, as well as reduced cost.

price is reasonable. If the selling price is twenty to twenty-five per cent. higher than the valuation, it may still be a fair price; but in proportion as the cost per ton exceeds the valuation there is reason to question the economy of its purchase.

2. Comparisons of the valuation and selling prices of a number of similar fertilizers will generally indicate fairly which is the best for the money.

But the valuation is not to be too literally construed, for in some cases analysis cannot discriminate positively between the active and the inert forms of nitrogen, while the mechanical condition of a fertilizer is an item whose influence cannot always be rightly expressed or appreciated.

For the above first-named purpose of valuation, the trade-values of the fertilizing elements which are employed in the computations should be as exact as possible, and should be frequently corrected to follow the changes in the market.

For the second-named use of valuation, frequent changes of the trade-value are disadvantageous, because two fertilizers cannot be compared as to their relative money-worth when their valuations are deduced from different data.

Experience leads to the conclusion that the trade-values adopted at the beginning of the year should be adhered to as nearly as possible throughout the year, notice being taken of considerable changes in the market, in order that due allowance may be made therefor.

For both of the above-named purposes, however, the intelligent purchaser can make a valuation of his own which will be much more reliable *for his individual case* than the average figures given in this report, because it applies specially to the time of his purchase and to the prices which he can get at that time. Thus he can learn by quotations given him by a number of dealers, the cheapest rates at which he can buy plant food, nitrogen, phosphoric acid and potash in raw materials; also the rates at which he can buy these same things in ready-mixed goods. With these facts before him he has a basis of valuation, accurate for the time when he buys, the market in which he buys and the cash or credit system on which he buys.

Agricultural Value of Fertilizers.

The Agricultural Value of a Fertilizer is measured by the benefits received from its use, and depends upon its fertilizing effect, or crop-producing power. As a broad, general rule, it is true that ground bone, superphosphates, fish scraps, dried blood, potash salts, etc., have a high agricultural value which is related to their trade-value, and to a degree determines the latter value. But the rule has many exceptions, and in particular instances the trade-value cannot always be expected to fix or even to indicate the agricultural value. Fertilizing effect depends largely upon soil, crop and weather, and as these vary from place to place and from year to year, it cannot be foretold or estimated, except by the results of past experience, and then only in a general and probable manner.

CLASSIFICATION OF FERTILIZERS ANALYZED.

1. *Containing Nitrogen as the chief valuable ingredient.*

Nitrate of Potash	1
Nitrate of Soda	8
Sulphate of Ammonia	1
Dried Blood	2
Cotton Seed Meal	94
Castor Pomace	3

2. *Containing Phosphoric Acid as the chief valuable ingredient.*

Dissolved Rock Phosphate	9

3. *Containing Potash as the chief valuable ingredient.*

Carbonate of Potash	11
High Grade Sulphate of Potash	2
Double Sulphate of Potash and Magnesia	3
Muriate of Potash	9
Kainit	2

4. *Containing Nitrogen and Phosphoric Acid.*

Bone Manures	28
Slaughter House Tankage	10
Dry Ground Fish	10

5. *Mixed Fertilisers.*

Bone and Potash	6
Nitrogenous Superphosphates and Guanos	93
Special Manures	127
Home Mixtures	10

6. *Miscellaneous Fertilizcrs and Manures.*

Tobacco Stems	1
Vegetable Ashes	6
Ashes of Tobacco Stalks	1
Cotton Hull Ashes	6
Wood Ashes	34
Lime Kiln Ashes	1
Oyster Shell Lime	2
Sheep Manure	6
Garbage Tankage	2
Cocoanut Pith	1
Total	489

DESCRIPTIONS AND ANALYSES OF FERTILIZERS.*

The samples referred to in the following pages were drawn by the Station agent, unless the contrary is stated.

The analyses were made by the methods adopted by the Association of Official Agricultural Chemists and the results are always expressed in percentages, or parts per hundred by weight, of the material examined.

In order to avoid confusion, each sample, as it is received, is given a consecutive number, by which it is distinguished in the laboratory. As the numbers had become so large as to be somewhat unwieldy, the numbering was begun again at unity in 1900.

I. RAW MATERIALS CHIEFLY VALUABLE FOR NITROGEN.

NITRATE OF POTASH.

A single sample sent by E. E. Burwell, New Haven, had the following percentage composition.

Nitrogen	12.88
Potash	43.20
Chlorine	2.78
Moisture	3.49

The price quoted was $75.00. Allowing 15½ cents per pound for the nitrogen of this sample, the actual potash cost 4.1 cents per pound, making the article, *at the price named,* a very economical source of nitrogen and potash.

NITRATE OF SODA OR SODIUM NITRATE.

Nitrate of Soda is mined in Chili and purified there before shipment. As offered in the Connecticut market it contains about 15.70 per cent. of nitrogen, equivalent to 95.3 per cent. of pure sodium nitrate, and is quite uniform in composition.

Eight samples from the Connecticut market have been received as follows:

10009. Stock of E. E. Burwell, New Haven.

10008. Stock of Connecticut School for Boys.

9798. Sold by Lowell Fertilizer Co., Boston. Stock of Andrew Ure, Hamden.

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* The analyses of fertilizers included in this chapter have been made by the chemists of the Station, Messrs. Winton, Ogden, Silverman and Bailey, with the help of Mr. Lange. The results have been tabulated and discussed by the director.

9963. Sold by Bowker Fertilizer Co., Boston. Stock of Theodore H. Howser, Suffield.

9928. Sold by American Agricultural Chemical Co., New York. Stock of E. N. Austin, Suffield.

10536. Sold by Wilcox Fertilizer Works, Mystic. Stocks of W. G. Atkins, Forestville, T. H. Eldridge, Norwich and Wilcox Fertilizer Works.

10535. Sold by Sanderson Fertilizer and Chemical Co., New Haven. Stock of Charles D. Torrey, Putnam.

9964. Stock of S. D. Woodruff & Sons, Orange.

ANALYSES OF NITRATE OF SODA.

Percentage amounts of	10009	10008	9798	9963	9928	10536	10535	9964
Nitrogen found	15.90	15.84	15.90	15.90	15.76	15.92	15.76	15.86
Equivalent nitrate of soda	96.5	96.1	96.5	96.5	95.7	96.6	95.7	96.3
Nitrogen guaranteed	16.00	....	15.6	....	15.8	15.6	....	15.8
Equivalent nitrate of soda guaranteed	97.1	....	95.0	....	95.9	94.7	....	96.0
Cost per ton	$45.00	45.00	45.00	46.00	46.50	47.50	50.00	....
Nitrogen costs cents per pound	**14.2**	**14.2**	**14.2**	**14.5**	**14.8**	**14.9**	**15.9**	....

All the samples of nitrate of soda examined in 1903 were of good quality and their composition in each case agreed substantially with the guarantee. The cost of nitrogen ranged from 14.2 to 15.9 cents per pound at the purchaser's freight station.

SULPHATE OF AMMONIA.

This material, which is made on a large scale as a by-product of gas works and coke ovens, usually contains over 20 per cent. of nitrogen, or the equivalent of 94-97 per cent. of pure ammonium sulphate.

9931. Sold by American Agricultural Chemical Co., New York. Stock of E. N. Austin, Suffield.

ANALYSIS.

Percentage amounts of	9931
Nitrogen	20.80
Equivalent sulphate of ammonia	98.0
Cost per ton	$70.00
Nitrogen costs cents per pound	**16.8**

Nitrogen in this form costs over two cents per pound more than in nitrate of soda and as a rule is of no greater value as a fertilizer.

DRIED BLOOD.

This is blood collected in slaughter houses, and dried by steam or hot air. It sometimes contains wool or hair in small amount and occasionally bone. It is therefore not at all uniform in composition, and for that reason the price varies with the actual composition. It is usually sold by the "unit of ammonia." A "unit" is one per cent., or 20 pounds *of ammonia;* but a "unit" of ammonia is about 16.5 pounds *of nitrogen.* Thus, if blood is quoted at $2.64 per unit of ammonia, the price of a pound of nitrogen will be $\frac{2.64}{16.5}$ or 16 cents.

9796. Sold by the Lowell Fertilizer Co., Boston. Stock of Andrew Ure, Hamden.

9932. Sold by American Agricultural Chemical Co., New York. Stock of E. N. Austin, Suffield.

ANALYSES.

Percentage amounts of	9796	9932
Nitrogen found	8.86	10.18
Nitrogen guaranteed	8.2	12.0
Cost per ton	$38.00	45.00
Nitrogen costs cents per pound	**21.4**	**22.1**

When organic nitrogen can be bought for 16 cents per pound in cotton seed meal and in form of nitrate for 14.5, it cannot pay the farmer to buy dried blood with the composition and prices given above.

COTTON SEED MEAL.

This material is of two kinds, which are known in trade respectively as undecorticated and decorticated. In their manufacture cotton seed is first ginned to remove most of the fiber, then passed through a "linter" to take off the short fiber or lint remaining, then through machines which break and separate the hulls. The hulled seed is ground and the oil expressed. The ground cake from the presses is used as a cattle food and fertilizer. Formerly the hulls were burned for fuel in the oil factories and the resulting ashes, which contained from 20 to 30 per cent. of potash, were used in this state as a tobacco fertilizer.

The hulls have, however, come into extensive use as a cattle food at the South, and now sell for this purpose at prices which forbid their use as a fuel.

Since large quantities of cotton seed meal are now used in this state as a tobacco fertilizer, and in view of the occasional trouble in making settlement with those manufacturers whose shipments showed a low percentage of nitrogen, the attention of wholesale buyers is called to the following rules of the Interstate Cotton Seed Crushers' Association, adopted at the Memphis meeting, May 26–28, 1903.

RULE 16. "Cotton Seed Meal, Choice—must be the product from choice cotton seed cake, when finely ground, must be perfectly sound, sweet and light color (canary), free from excess of lint and hulls. Analysis must contain at least 8 per cent. ammonia."

RULE 17. "Prime—must be made from prime cake, finely ground, of sweet odor, reasonably bright in color, yellow, not brown or reddish, and free from excess of lint or hulls, and by analysis must contain at least 8 per cent." (of ammonia) "for meal from Texas and the Mississippi Valley and 7½ per cent. for meal from the South Atlantic States."

RULE 46. Meal. "Two ounces or more from a sack shall constitute a sample of meal and must be drawn so as to fairly represent the entire contents of the bag. Twenty samples from each carload or 50 sacks from each 100 tons, if not shipped in car lots, shall be sufficient to represent a shipment."

Hence if a bargain is made for "Choice" cotton seed meal, the seller must deliver meal containing at least eight per cent. of ammonia, which is equivalent to 6.59 per cent. of nitrogen or 41.19 per cent. of protein.

If a bargain is made for "Prime" cotton seed *from Texas or the Mississippi Valley*, the delivered meal must contain at least the percentages named above. But if "Texas or the Mississippi Valley" is not specified in the order, the buyer may have to content himself with 7½ per cent. of ammonia, equal to 6.18 per cent. nitrogen or 38.62 per cent. protein; which is very low grade.

It has been usual in past years for dealers to guarantee 7.0 per cent. of nitrogen, and two-thirds of the samples whose analyses are given below had this percentage or more, and all but six of them contained at least 6.75 per cent. of nitrogen.

In the table, pages 23-26, are analyses of ninety-four samples of cotton seed meal from stock bought chiefly, if not wholly, for use as a fertilizer.

The percentage of phosphoric acid in cotton seed meal ranges from 2.69 to 3.44, and that of potash from 1.64 to 2.00, the average being 3.15 and 1.90, respectively. The cost per pound of nitrogen is determined in each case by deducting $4.42—the valuation of the phosphoric acid and potash—from the ton price, and dividing the remainder by the number of pounds of nitrogen in a ton of meal.

The average ton cost of cotton seed meal has been $26.96, somewhat lower than in 1902.

The percentage of nitrogen found in the samples examined has ranged from 4.08, or, excluding one sample, from 5.96 to 7.96, the average, excluding the single sample with least nitrogen, being 7.09, the same average as last year.

The cost of nitrogen ranged from 13.6 to 18.7 cents per pound, with the exception named above, and the average was 16.0, also the same as last year.

Special attention is called to sample **10062**. This sample has a yellow color, scarcely different from that of prime cotton seed meal. The analysis in the table shows it to be a very inferior meal, in composition quite like ground, undecorticated cotton seed meal which can be readily distinguished from decorticated meal by its appearance.

In the sample in question, the hulls have been very finely ground, by which their presence is concealed from the buyer. This sample came from the Sledge Wells Co. of Memphis, Tenn. It was bought by R. H. Ensign from Chapin & Co. of Boston. Before the sample was received Chapin & Co. wrote regarding it, "This was bought by us for prime meal, but from one other car that we have had analyzed we are afraid it is greatly inferior and have so advised the buyer."

ANALYSES OF COTTON SEED MEAL.

Station No.	Dealer.	Sampled or sent by	Per cent. of nitrogen.	Cost per ton.	Nitrogen costs cents per pound.
9859	Arthur Sikes, Suffield	David L. Brockett, Suffield, and others	7.96	$26.00	13.6
9845	" " "	Dan I. King, Suffield	7.92	26.00	13.6
9856	" " "	W. H. Prout, Suffield, and others	7.85	26.00	13.7
9846	" " "	K. McCabe, Windsor Locks	7.84	26.00	13.8
9853	" " "	W. A. Soper and E. C. Holdridge, Suffield	7.84	26.00	13.8
9844	" " "	C. F. Tilden and Chas. T. Remington, Suffield	7.94	26.50	13.9
9854	" " "	W. E. Ford, Suffield, and others	7.90	26.50	14.0
9857	" " "	C. H. Nelson, W. Suffield, and others	7.90	26.50	14.0
9962	" " " off color	Wm. W. Thompson, Warehouse Point	7.38	26.00	14.6
9855	" " " "	E. S. Seymour, Windsor Locks	7.34	26.00	14.7
9976	" " " "	Thos. J. Noone, Suffield, and others	7.25	26.00	14.9
9915	" " "	Chas. J. Stiles and H. Dowd Hastings, Suffield	7.20	26.00	15.0
9972	" " "	Wm. H. Orr and Samuel Orr, W. Suffield	7.17	26.00	15.0
9946	J. G. Dickinson, East Granby, R. W. Biggs & Co.	Patrick Connor, Poquonock	7.35	26.50	15.0
10859	Olds & Whipple, Hartford, dark	E. P. Brewer, Silver Lane	6.84	25.00	15.0
9878	Arthur Sikes, Suffield	Samuel Barr, Suffield, and others	7.19	26.00	15.0
9984	" " " off color	John E. Chamberlain, Broad Brook	7.32	26.50	15.1
10098	" " " "	H. D. Sikes, Suffield, and others	7.16	26.00	15.1
9947	" " "	C. P. Viets, E. Granby	7.30	26.50	15.1
9975	" " " off color	Patrick Quinn, Suffield, and others	7.34	26.50	15.1
9870	" " "	Timothy Miskill, Suffield, and others	7.13	26.00	15.1
9823	dark	C. H. Dexter & Sons, Windsor Locks	7.64	27.50	15.1
9937	Arthur Sikes, Suffield	J. E. Phelps, Suffield, and others	7.12	26.00	15.2
9879	" " "	O. W. Kellogg, Suffield, and others	7.08	26.00	15.2
9918	" " " off color	Geo. A. Peckham and W. K. Freeman, Suffield	7.24	26.50	15.2
9877	" " "	W. E. Russell and J. B. Fairfield, Suffield	7.08	26.00	15.2

ANALYSES OF COTTON SEED MEAL.—*Continued.*

Station No.	Dealer.	Sampled or sent by	Per cent. of nitrogen.	Cost per ton.	Nitrogen costs cents per pound.
9861	Arthur Sikes, Suffield	John F. Brockett, Suffield, and others	7.10	$26.00	15.2
10097	" " " off color	Geo. D. Austin, Suffield	7.04	26.00	15.3
9889	" " " "	F. B. Hatheway, Suffield	7.01	26.00	15.4
9919	" " "	Samuel Barr and Robert Bawn, Suffield	7.15	26.50	15.4
9821	dark	C. H. Dexter & Sons, Windsor Locks	7.50	27.50	15.4
9869	Arthur Sikes, Suffield, off color	A. C. Ludden, Suffield, and others	7.17	26.50	15.4
9981	" " " "	A. H. Brown, Poquonock	7.08	26.25	15.4
9858	" " "	Frank F. Ford and Robert Bawn, Suffield	7.00	26.00	15.4
9980	" " " off color	H. W. Alford, Poquonock, and L. D. Fairbanks, Windsor	7.06	26.25	15.5
9860	" " "	H. W. Prout, Suffield	6.97	26.00	15.5
9922	E. N. Austin, Suffield, Old Gold Brand	Station Agent	6.98	26.00	15.5
9916	Arthur Sikes, Suffield	W. H. Hastings, Suffield, and others	7.11	26.50	15.5
9982	" " " off color	A. E. Holcomb, Poquonock	7.01	26.25	15.6
9801	J. E. Soper & Co.	Edmund Halladay, Suffield	7.55	28.00	15.6
10005	Arthur Sikes, Suffield, off color	Stanton F. Brown, Windsor, and others	7.00	26.25	15.6
9822	dark	C. H. Dexter & Sons, Windsor Locks	7.40	27.50	15.6
9876	Daniels Mill Co., Hartford	John B. Parker, Poquonock	7.20	27.00	15.7
10006	Arthur Sikes, Suffield, dark	Thos. L. Kenney, R.F.D.2, Suffield	6.87	26.00	15.7
9977	" " " off color	B. A. Thompson and G. W. Phelps, Suffield	6.84	26.00	15.8
9959	" " " "Offcaro"	Geo. S. Phelps, Warehouse Point	6.80	26.00	15.9
9830		A. W. Camp, Danbury	7.41	28.00	15.9
10003	Arthur Sikes, Suffield, off color	Howard A. Button, Suffield, and others	6.79	26.00	15.9
10060	C. D. Clark, Granby, "Canary"	F. M. Colton, Granby	7.36	28.00	16.0
9960	Olds & Whipple, Hartford, dark	Clark Bros., Poquonock	6.60	25.50	16.0
9951	Arthur Sikes, Suffield, off color	G. S. & Wm. Phelps, Warehouse Point	6.76	26.00	16.0

ANALYSES OF COTTON SEED MEAL.—*Continued.*

Station No.	Dealer.	Sampled or sent by	Per cent. of nitrogen.	Cost per ton.	Nitrogen costs cents per pound.
10230	Olds & Whipple, Hartford	E. P. Brewer, Silver Lane	7.36	$28.00	16.0
9979	Arthur Sikes, Suffield	Hugh W. Biggerstaff, R.F.D.2, Suffield, and others	7.33	28.00	16.1
9923	David H. McComb, Suffield	Station Agent	7.32	28.00	16.1
9936	Arthur Sikes, Suffield	A. N. Graves, Suffield	6.98	27.00	16.2
9917	" " " off color	Fish & Kent and Geo. Clark, Suffield	6.82	26.50	16.2
10019	" " " "	J. T. Cain, Suffield, and others	6.68	26.00	16.2
9978	" " " "	Geo. A. Douglass, Thompsonville	6.63	26.00	16.3
9973	" " "	A. N. Graves, Suffield	6.94	27.00	16.3
9938	" " "	" " "	6.94	27.00	16.3
10043	" " "	" " "	6.92	27.00	16.3
10034	" " "	John Sullivan, Suffield	6.94	27.25	16.4
9914	Ackley, Hatch & Marsh, New Milford, Green Diamond Brand	Dealer	7.63	29.50	16.4
9949	Arthur Sikes, Suffield	Robert J. Hamilton, Suffield, and others	7.14	28.00	16.5
9807	C. H. Dexter & Sons, Windsor Locks	F. A. Hamilton, Warehouse Point	6.86	27.00	16.5
9868	Chas. M. Cox & Co., Boston, Mass., Magnolia Brand	New Hartford Elevator Co., New Hartford	7.31	28.50	16.5
9983	Arthur Sikes, Suffield, off color	Carey Bros., Windsor, and others	6.58	26.25	16.6
9974	" " " "	W. G. Smith and H. Weber, Windsor	6.59	26.25	16.6
9831		C. H. Dexter & Sons, Windsor Locks	7.38	29.00	16.7
10229	Chas. D. Clark, Granby, R. W. Biggs & Co.	R. W. Griffin, Granby	7.08	28.00	16.7
10220	Spencer Bros., Suffield, Am. Cotton Oil Co.	Wm. C. Vietts, Suffield	6.92	27.50	16.7
9950	Arthur Sikes, Suffield	F. H. Thrall, Box 87, Windsor	6.51	26.25	16.8
10124	C. D. Clark, Granby, R. W. Biggs & Co.	L. R. Griffin, Granby	7.02	28.00	16.8
10073	Horace K. Brainard, Thompsonville, Old Gold Brand	Seth Alden, Thompsonville	7.02	28.00	16.8

ANALYSES OF COTTON SEED MEAL.—*Continued.*

Station No.	Dealer.	Sampled or sent by	Per cent. of nitrogen.	Cost per ton.	Nitrogen costs cents per pound.
10004	Arthur Sikes, Suffield	John Sullivan, Suffield	6.78	$27.25	$16.8
10007	" " "	Jacob Lang, R.F.D. Windsor	6.51	26.25	16.8
10176	Olds & Whipple, Hartford	H. H. Wilbraham, Poquonock	7.28	29.00	16.9
9948	Arthur Sikes, Suffield	John Sullivan, Suffield	6.74	27.25	16.9
10061	C. D. Clark, Granby, R. W. Biggs & Co.	E. B. Case, Granby	7.06	28.25	16.9
10072	S. J. Stevens, Glastonbury, Star Brand	W. I. Stevens & Son, Hockanum	6.78	27.50	17.0
9952	The John S. Wolfe Co., Pittsfield, Mass.	Ackley, Hatch & Marsh, New Milford	7.23	29.00	17.0
9843	Spencer Bros., Suffield, Am. Cotton Oil Co.	D. A. Woodworth, Suffield	7.34	29.50	17.1
9961	Arthur Sikes, Suffield	John Sullivan, Suffield	6.65	27.25	17.2
10035	C. D. Clark, Granby	Alfred H. Griffin, Granby	6.88	28.25	17.3
10059	" " " R. W. Biggs & Co.	L. C. Spring, Granby	6.87	28.25	17.3
10096	" " "	Alfred H. Griffin, Granby	6.80	28.25	17.5
9913	Ackley, Hatch & Marsh, New Milford, J. E. Soper & Co.	Dealer	7.14	29.50	17.6
9871	Ackley, Hatch & Marsh, New Milford	A. W. Camp, Danbury	6.71	28.00	17.6
9911	Ackley, Hatch & Marsh, New Milford	W. H. Camp, R.F.D.2, New Milford	6.66	28.00	17.7
9867	Chapin & Co., St. Louis, Green Diamond Brand	New Hartford Elevator Co., New Hartford	6.67	28.50	18.0
10552	Daniels Mill Co., Hartford	Byron B. Barnard, Bloomfield	6.20	27.00	18.2
10153	" " "	H. S. Pomroy, Suffield	5.96	26.50	18.5
9912	Ackley, Hatch & Marsh, New Milford, Sunflower Brand	Dealer	6.58	29.00	18.7
10062	Sledge Wells Co., Memphis, Tenn.*	R. H. Ensign, Simsbury	4.08	28.00	28.9

* See note, page 22.

CASTOR POMACE.

This is the ground residue of castor beans from which castor-oil has been expressed or extracted. The nitrogen which it contains is quickly available to plants, but the pomace is extremely poisonous to animals, which often eat it greedily when the opportunity offers.

10276. Sold by H. J. Baker & Bro., New York. Stock of Spencer Brothers, Suffield, and of W. F. Andross, East Hartford.

10275. Sold by Bowker Fertilizer Co., New York. Stock of Bowker's Branch, Hartford.

10071. Sold by American Agricultural Chemical Co., New York. Stock of S. J. Stevens, Glastonbury.

ANALYSES.

	10276	10275	10071
Percentage amounts of			
Nitrogen found	5.13	5.00	4.46
Nitrogen guaranteed	....	4.1	4.1
Cost per ton	$23.00	23.00	23.00
Nitrogen costs cents per pound	**19.9**	**20.5**	**23.0**

Castor pomace, as appears from the determinations made at this Station within the last three years, contains, on the average, 1.95 per cent. of phosphoric acid and 0.98 per cent. of potash. Valuing these at 4 and 5 cents per pound respectively, the cost of nitrogen per pound, in the three samples above noted, ranges from 19.9 to 23.0 cents per pound. This is too high a price to pay for organic nitrogen for any crop.

II. RAW MATERIALS CHIEFLY VALUABLE FOR PHOSPHORIC ACID.

DISSOLVED ROCK PHOSPHATE OR ACID ROCK.

This material, made by treating various mineral phosphates with oil of vitriol, has been practically the only form in which water-soluble phosphoric acid could be bought during the past year.

Dissolved bone black has not appeared in the market.

10016. Sold by the American Agricultural Chemical Co., New York. Stock of Connecticut School for Boys, Meriden.

9934. Sold by American Agricultural Chemical Co. Stock of E. N. Austin, Suffield.

10533. Sold by the Sanderson Fertilizer and Chemical Co., New Haven, and sampled from their stock.

10018. Stock of E. E. Burwell, New Haven.

10534. Sold by Wilcox Fertilizer Works, Mystic. Stock of W. G. Atkins, Forestville and of manufacturers.

10017. Sold by Bowker Fertilizer Co., New York. Stock of Bowker's Branch, Southport.

9799. Sold by Swift's Lowell Fertilizer Co., Boston, Mass. Stock of Andrew Ure, Highwood.

9769. Stock of E. R. Kelsey, Short Beach.

9965. Stock of S. D. Woodruff & Sons, Orange.

The cost of available phosphoric acid in these samples has ranged from 4.0 to 5.9 cents per pound.

All the samples have contained the guaranteed percentages of "available," that is, soluble and reverted phosphoric acid.

ANALYSES OF DISSOLVED ROCK PHOSPHATE.

	Am. Agl. Chem. Co.		Sanderson.	Burwell.	Wilcox.	Bowker.	Swift's Lowell.	Kelsey.	Woodruff.
Percentage amounts of	10016	9934	10533	10018	10534	10017	9799	9769	9965
Phosphoric acid, water-soluble	11.60	12.53	11.12	12.38	12.18	12.91	10.40	12.32	11.02
Phosphoric acid, citrate-soluble	2.66	2.69	3.69	2.01	2.52	1.53	1.92	5.81	3.91
Phosphoric acid, insoluble	0.95	0.77	0.76	1.09	1.19	0.80	1.41	0.53	1.01
Phosphoric acid, total	15.21	15.99	15.57	15.48	15.89	15.24	13.73	18.66	15.94
Available phosphoric acid found	14.26	15.22	14.81	14.39	14.70	14.44	12.32	18.13	14.93
Available phosphoric acid guaranteed	14.0	14.0	14.0	14.0	14.0	13.0	12.0	17.0	14.0
Cost per ton	$12.00*	13.50	14.00	14.00	15.00	15.00	15.00	....	....
Available phosphoric acid costs cents per pound	4.0	4.3	4.6	4.7	4.9	5.1	5.9	....	....

* Mixed car lot.

III. RAW MATERIALS OF HIGH GRADE CONTAINING POTASH.

CARBONATE OF POTASH.

Commercial carbonate of potash has to some extent taken the place of cotton hull ashes as a source of potash for tobacco lands. It comes in casks, holding about one thousand pounds, and is a white granular solid which gathers moisture quickly if exposed to damp air and becomes noticeably moist and sticky. It must therefore be kept in tight, closed packages until needed for use. The lumps which are found in it are easily screened out and pulverized. There was no difficulty found in making, storing, or applying a mixture of cotton seed meal and carbonate of potash. If the mixture were kept over for a season, especially if it got damp, there is litttle doubt that it would cake badly in bags and liberate some nitrogen in form of ammonia from the meal. This tendency to absorb water makes the matter of proper sampling more than usually difficult and it is quite possible that some of the analyses given below do not accurately represent the quality of the packages from which they were drawn.

The guarantees also are quite unintelligible. The lowest guarantee is 90 per cent., the highest 96 per cent., of "carbonate of potash." If this means anhydrous carbonate, some of the samples are much below guarantee, as for example, Nos. **9873** and **9875**. If, on the other hand, it means hydrous carbonate with about 16 per cent. of water, ($2K_2CO_3.3H_2O$), certain samples, like **9957**, contain a great deal more potash than is guaranteed.

A guarantee of *actual potash* is what is desired. The equivalents of the three things are as follows:

Actual potash.	Equivalent anhydrous carbonate of potash.	Equivalent hydrated carbonate of potash.
52.5	77.0	92.1
55.0	80.7	96.5
57.0	83.6	100.0
57.5	84.4	----
60.0	88.0	----
61.3	90.0	----
62.5	91.7	----
65.0	95.4	----
65.4	96.0	----
67.5	99.0	----
68.2	100.0	----

Analyses of seven samples appear in the table below.

9873 and **9874.** Stock of T. Sisson & Co., Hartford. **9873,** of English Manufacture, guaranteed 95 per cent. **9874,** of French make and said to be very high grade. Price 4½ cents per pound.

9782. Unground. Sold by H. J. Baker & Bro., New York. Sent by Indian Head Plantations, Inc. Price 3⅞ cents per pound net cash, ex. steamer N. Y. invoice weights and analyses.

9842. Sold by A. Klipstein & Co., New York. Sent by Indian Head Plantations, Inc. Guaranteed 96 to 98 per cent.

10125. Sold by A. Klipstein & Co., New York. Sent by J. E. Phelps, Suffield. Guaranteed 96 per cent. carbonate. Cost 4¼ cents per pound.

9875 and **9957.** Sold by Roessler & Hasslacher, New York. Sent by Indian Head Plantations, Inc. This first sample 9875 was a small one taken from the exposed surface. 9957 was a pint sample taken a foot below the top of the cask.

ANALYSES.

Percentage amounts of	9873	9874	9782	9842	10125	9875	9957
Moisture	17.49	15.40	....	....	....	16.86	4 45
Sulphuric acid	trace	trace	....	....	....	trace	....
Chlorine	0.77	0.61	0.48	0.10	0.63	0.50	0.57
Potash	53.93	55.80	63.01	62.25	62.89	56.10	64.65
Equivalent anhydrous "calcined" carbonate	79.1	81.9	92.4	91.5	92.3	82.3	94.9
Equivalent hydrated carbonate	94.6	97.9	....	....	....	98.4	....
Guaranteed "carbonate"	95.0	....	....	96.0	....	96.0	96.0
Cost per pound, cents	4½	4½	3⅞*	- --	4¼	4½†	4½†
Potash costs cents per pound	8.3	8.1	6.1	....	6.8	8.0	7.0

* On Steamer N. Y. net cash, foreign weights and analyses.

† f.o.b. N. Y.

THE USE OF CARBONATE OF POTASH IN TOBACCO FERTILIZERS.

The object of using carbonate of potash in tobacco fertilizers is to exclude both muriates and sulphates. The reason for excluding them is that it has long been known that the burning quality of wrapper leaf tobacco is injured if muriates (chlorides) are used in considerable amount in the fertilizer, and our five-year tests showed that the continued use of large amounts of sulphates did a similar injury, though much less pronounced, than that from muriates. Our experiments, as well as the experience of growers of tobacco in Connecticut, have also proved that the carbonate is one of the best forms, if not the very best, in which to supply potash to the tobacco crop.

It is an expensive form of potash, but its use is rational, *if thereby sulphates and muriates are excluded.* But it is quite irrational, because wasteful, to use carbonate of potash in a mixed fertilizer and to introduce into the mixture at the same time, either sulphates or muriates in other forms than in potash salts, for instance as acid fish, dissolved phosphate or plaster, for there is no doubt that sulphates or muriates may be equally harmful to the quality of the tobacco leaf, whether introduced into the fertilizer as potash salts or in other forms.

The writer believes that carbonate of potash in some form or other will always be preferred by growers who strive to get the best possible quality of leaf.

On the other hand, he does not believe that small amounts of chlorine, or much larger amounts of sulphuric acid, are likely to injure the quality of a tobacco crop, if the supply of available potash is abundant in the soil. Ten cords of stable manure, not an unusual dressing per acre, carries 35 pounds of chlorine in it, but all agree that no fertilizer yields a better quality of leaf than stable manure, supplemented with commercial fertilizers.

Now a ton of commercial fertilizer containing 1.7 per cent. of chlorine would carry no more chlorine to the crop than a heavy dressing of horse manure.

It is also well known that an amount of chlorides which damages the quality of tobacco when the supply of potash is limited, has much less effect when this supply is abundant.

There is no such thing as a "best" formula for a tobacco fertilizer. No fertilizer is "best" through an indefinite term of years. An occasional change of formula helps to rid the land of residues from the fertilizers previously applied, which in time might accumulate sufficiently to be injurious.

HIGH GRADE SULPHATE OF POTASH.

This chemical should contain over 90 per cent. of pure potassium sulphate (sulphate of potash), or about 50 per cent. of potassium oxide, the same quality as is supplied by muriate, and should be nearly free from chlorine.

The analyses of two samples appear in the table, page 34.

As a source of potash in form of sulphate the "low grade" or double sulphate of potash and magnesia seems to be preferred, although the average cost of actual potash is about as high in the "low grade" sulphate.

DOUBLE SULPHATE OF POTASH AND MAGNESIA.

This material is usually sold as "sulphate of potash" or "manure salt," on a guarantee of "48–50 per cent. sulphate," which is equivalent to 25.9-27.0 per cent. of potassium oxide. Besides some 46-50 per cent. of potassium sulphate, it contains over 30 per cent. of magnesium sulphate, chlorine equivalent to 3 per cent. of common salt, a little sodium and calcium sulphates, with varying quantities of moisture.

Three analyses of this sulphate are given in the table on page 34.

The cost of actual potash per pound in these samples was 5.1 cents.

MURIATE OF POTASH.

Commercial muriate of potash contains about 80 per cent. of muriate of potash (potassium chloride), 15 per cent. or more of common salt (sodium chloride), and 4 per cent. or more of water.

In the table on page 34 are given nine analyses of muriate of potash.

All are of fairly good quality. Two of the samples, 9929 and 9767, had not the guaranteed composition.

The cost of actual potash in this form has ranged from 4.0 to 4.7 cents per pound.

KAINIT.

Kainit is less uniform in composition than the other potash salts. In contains from 11 to 15 per cent. of potash, more than that quantity of soda, and rather less magnesia. These "bases"

POTASH SALTS. PERCENTAGE COMPOSITION AND

Station No.	Drawn from Stock in possession of	Sampled and sent by
	High Grade Sulphate of Potash.	
9930	E. N. Austin, Suffield	Station Agent
10126	S. J. Stevens, Glastonbury	W. I. Stevens & Son, Hockanum
	Double Sulphate of Potash.	
10013	Connecticut School for Boys, Meriden	Station Agent
10537	Sanderson Fertilizer & Chemical Co., New Haven	" "
9768	E. R. Kelsey, Short Beach	E. R. Kelsey, Short Beach
	Muriate of Potash.	
10011	Connecticut School for Boys, Meriden	Station Agent
10249	Sanderson Fertilizer & Chemical Co., New Haven	" "
9797	Andrew Ure, Highwood	" "
10012	Bowker's. E. E. Burwell, New Haven	" "
10170	Am. Ag'l. Chem. Co.'s. Ernest N. Austin, Suffield	Ernest N. Austin, Suffield
10248	Wilcox Fertilizer Works, Mystic W. G. Atkins, Forestville	Station Agent " "
9929	Am. Ag'l. Chem. Co.'s. E. N. Austin, Suffield	" "
9969	S. D. Woodruff & Sons, Orange	" "
9767	E. R. Kelsey, Short Beach	E. R. Kelsey, Short Beach
	Kainit.	
10038	Connecticut School for Boys, Meriden	Station Agent
10037	J. G. Schwink, Meriden	" "

are combined with chlorine and sulphuric acid. Unless "calcined," it contains more water than occurs in sulphate or in muriate of potash. It is usually sold on a guarantee of 12 to 15 per cent. of potash, or 23 to 25 per cent. "sulphate of potash." It is not properly called, or claimed to be, a sulphate of potash, since it contains more than enough chlorine to combine with all the potash present, and there are sound reasons for believing that its potash exists chiefly as muriate and, to a much less extent, as sulphate. Its action and effects are unquestionably those of a muriate rather than of a sulphate.

The two samples analyzed, see table above, contained less than 12 per cent. of potash and at the prices quoted, potash cost 5.1 and 5.2 cents per pound.

COST PER POUND OF POTASH.

Station No.	Percentages found.				Percentages guaranteed.		Cost per ton.	Potash costs cents per pound.
	Chlorine.	Potash Soluble in water.	Equivalent Muriate.	Equivalent Sulphate.	Muriate.	Sulphate.		
9930	2.61	49.72	....	91.98	....	88.8	$48.00	4.8
10126	....	49.54	....	91.65	....	90.0	55.00	
10013	....	26.48	....	48.99	....	....	27.00	5.1
10537	....	27.32	....	50.54	....	50.0	28.00	5.1
9768	1.61	26.54	....	49.10	....	53.0	....	...
10011	....	52.27	82.59	....	....	....	42.00	4.0
10249	....	53.04	83.80	....	79.0	....	45.00	4.2
9797	....	51.74	81.75	....	80.0	....	45.00	4.3
10012	....	51.70	81.69	....	79.0	....	44.00	4.3
10170	....	51.79	81.83	....	79.0	....	46.00	4.4
10248	....	50.74	80.17	....	79.0	....	45.00	4.4
9929	....	48.98	77.39	....	79.0	....	46.50	4.7
9969	....	50.96	80.52	....	80.0	....	....	...
9767	....	49.32	77.93	....	81.4	....	....	...
10038	....	11.69	....	21.63	....	....	12.00	5.1
10037	....	11.56	....	21.39	....	22.2	12.00	5.2

IV. RAW MATERIALS CONTAINING NITROGEN AND PHOSPHORIC ACID.

BONE MANURES.

The terms "Bone Dust", "Ground Bone", "Bone Meal" and "Bone" applied to fertilizers, sometimes signify material made from dry, clean and pure bones; in other cases these terms refer to the result of crushing fresh or moist bones which have been thrown out either raw or after cooking, with more or less meat, tendon and grease, and—if taken from garbage or ash heaps—with ashes or soil adhering; again they denote mixtures of bone, blood, meat and other slaughter-house refuse which have been cooked in steam tanks to recover grease, and are then dried and sometimes sold as "tankage"; or finally, they apply to bone from which a large share of the nitrogenous substance has been extracted in the glue manufacture. When they are in the same state of mechanical subdivision the nitrogen of all these varieties of bone probably has about the same fertilizing value.

The method adopted for the valuation of bone manures, which takes account of their mechanical condition as well as chemical composition, is explained on page 15.

1. *Bone Manures Sampled by Station Agents.*

In the table on pages 38 and 39 are given twenty-five analyses of samples of this class.

GUARANTEES.

Six of the samples were found to contain less nitrogen or phosphoric acid than was guaranteed by the manufacturers. In most cases when the percentage of one ingredient was quite below the guarantee, that of the other was correspondingly high.

The following brands failed to meet the guarantee in one or more particulars:

10141. Downs & Griffin's Ground Bone. Nitrogen found 2.94, guaranteed 4.0.

10132. Rogers' Pure Fine Ground Bone. Phosphoric acid found 23.84, guaranteed 24.0.

10128. Shay's Ground Bone. Nitrogen found 2.52, guaranteed 2.7.

10147. Berkshire Ground Bone. Phosphoric acid found 18.61, guaranteed 20.0.

10136. Chittenden's Fine Ground Bone. Nitrogen found 2.65, guaranteed 2.9.

10068. James' Ground Bone. Nitrogen found 3.82, guaranteed 4.0.

COST AND VALUATION.

The price printed in full-face type in the column showing cost per ton is the one used in calculating the percentage difference between cost and valuation.

The average cost of these bone manures is $29.78 per ton; the average valuation $26.18; showing that the Station valuation is somewhat lower than the average selling price of ground bone in Connecticut.

2. *Sampled by Purchasers.*

In the table on pages 38 and 39 are analyses of three samples sent by purchasers, and not drawn by the Station agent.

SLAUGHTER-HOUSE TANKAGE.

After boiling or steaming meat scrap, bone and other slaughter-house waste, fat rises to the surface and is removed, the soup is run off and the settlings are dried and sold as tankage. As analyses show, tankage has a very variable composition. In general, it contains more nitrogen and less phosphoric acid than bone. Garbage tankage, made in a somewhat similar way from city garbage, is described on page 98.

In the table, pages 40 and 41, are found four analyses of this material, made on samples drawn by the Station agent and five made on samples drawn by others.

These analyses show the usual differences in chemical composition.

DRY GROUND FISH.

This residue from the manufacture of fish oil is often sprinkled with diluted oil of vitriol, to check putrefaction, whereby the fish bones are softened and to some extent dissolved.

Ten analyses are given on page 42.

10283. Sold by Bowker Fertilizer Co., New York. Stock of Bowker's Branch, Hartford.

10245. Sold by Russia Cement Co., Gloucester, Mass. Stock of J. A. Lewis' Estate, Willimantic, J. & H. Woodford, Avon, and W. J. Cox, East Hartford.

10169. Sold by American Agricultural Chemical Co., New York. Stock of Ernest Austin, Suffield. Sampled and sent by E. Austin.

10267. Sold by Wilcox Fertilizer Works, Mystic. Stock of Spencer Bros., Suffield.

9933. Sold by American Agricultural Chemical Co., New York. Stock of E. N. Austin, Suffield.

10268. Sold by Sanderson Fertilizer Co., New Haven. Stock of J. H. Hackett, Wapping.

10070. Sold by American Agricultural Chemical Co., New York. Stock of S. J. Stevens, Glastonbury. Sampled and sent by W. I. Stevens & Son, Hockanum.

9746. Sold by Bowker Fertilizer Co., New York. Stock of M. Daley. Sampled and sent by W. J. Warner, Hebron.

10284. Sold by Bowker Fertilizer Co., New York. Stock of E. E. Burwell, New Haven.

PERCENTAGE COMPOSITION AND

Station No.	Name or Brand.	Manufacturer.
	Sampled by Station Agents.	
10146	Self-Recommending Fertilizer	Valentine Bohl, Waterbury
10143	Pure Bone Dust	Peter Cooper's Glue Factory, New York
10140	Shoemaker's Swift-Sure Bone Meal	M. L. Shoemaker & Co., Philadelphia, Pa.
10139	Frisbie's Fine Bone Meal	The L. T. Frisbie Co., Hartford
10141	Pure Ground Bone	Downs & Griffin, Derby
10127	Wilcox Pure Ground Bone	The Wilcox Fertilizer Works, Mystic
10132	Pure Fine Ground Bone	The Rogers Mfg. Co., Rockfall
10131	Fine Knuckle Bone	The Rogers Mfg. Co., Rockfall
10148	Armour's Bone Meal	Armour Fertilizer Works, Baltimore, Md.
10138	Swift's Lowell Ground Bone	Lowell Fertilizer Co., Boston
10130	Essex Fine Bone Meal	Russia Cement Co., Gloucester, Mass.
10128	Shay's Ground Bone	C. M. Shay, Groton
10144	E. Frank Coe's XXX Ground Bone	E. Frank Coe Co., New York
10149	Fine Ground Bone	Am. Agricultural Chemical Co., N. Y.
10532	Lister's Pure Raw Bone Meal	Lister's Agricultural Chem. Co., Newark, N. J.
10147	Fine Ground Bone	Berkshire Fertilizer Co., Bridgeport
10135	Ground Bone	Plumb & Winton, Bridgeport
10136	Chittenden's Fine Ground Bone	National Fertilizer Co., Bridgeport
10142	Ground Bone	E. C. Dennis, Stafford Springs
10133	Hubbard's Raw Knuckle Bone Flour	The Rogers & Hubbard Co., Middletown
10134	Hubbard's Pure Fine Bone	The Rogers & Hubbard Co., Middletown
10137	Mad River Strictly Pure Ground Bone	Wm. MacCormack, Wolcott
10068	Ground Bone	E. L. James, Warrenville
10129	Sanderson's Fine Ground Bone	Sanderson Fertz. & Chem. Co., New Haven
10145	Bowker's Fresh Ground Bone	Bowker Fertilizer Co., New York
	Sampled by Purchasers.	
9910	Bone Dust	Peter Cooper's Glue Factory, New York
9945	Self-Recommending Fertilizer	Valentine Bohl, Waterbury
10069	Bone Meal	M. L. Shoemaker & Co., Philadelphia, Pa.

VALUATION OF BONE MANURES.

Dealer.	Dealer's cash price per ton.	Valuation per ton.	Percentage difference between cost and valuation.	Chemical Analysis.				Mechanical Analysis.	
				Nitrogen.		Phosphoric acid.			
				Found.	Guaranteed	Found.	Guaranteed.	Finer than 1-50 inch.	Coarser than 1-50 inch.
D. B. Wilson Co., Waterbury	**$25.00**	$26.64	6.2†	3.62	**3.7**	23.31	**24.6**	50	50
Geo. Beaumont, Wallingford	**25.00**	24.44	2.3	1.30	....	29.42	....	52	48
E. A. Buck & Co., Willimantic	**35.00**	33.77	3.6	5.22	**4.1**	24.52	**20.0**	68	32
J. P. Barstow & Co., Norwich	35.00								
F. H. Rolf, Guilford	35.00								
Edward White, Rockville	**28.00**	26.74	4.7	4.36	**3.3**	20.44	**18.0**	50	50
Manufacturer	**30.00**	27.76	8.1	2.94	**4.0**	26.21	**23.7**	63	37
T. H. Eldredge, Norwich	**30.00**	27.53	9.0	2.88	**2.5**	26.14	**22.0**	63	37
W. A. Howard, Woodstock	31.00								
I. W. Dennison, Mystic	29.00								
Rockville Milling Co., Rockville	32.00	28.42	9.1	3.88	**3.4**	23.85	**24.0**	58	42
E. E. Burwell, New Haven	30.00								
	31.00								
E. E. Burwell, New Haven	**32.00**	29.31	9.2	4,05	**3.8**	25.88	**24.0**	46	54
E. A. Buck & Co., Willimantic	**29.00**	26.46	9.6	3.17	**2.5**	24.56	**24.0**	53	47
R. H. Hall, East Hampton	30.00								
H. A. Bugbee, Willimantic	**30.00**	27.36	9.6	2.57	**2.5**	27.17	**25.0**	63	37
J. P. Barstow & Co., Norwich	32.00								
Spencer Bros., Suffield	31.00	27.38	11.4	4.51	**3.3**	20.39	**18.0**	53	47
Henry Davis, Durham Center	30.00								
	30.50								
Manufacturer	**30.00**	26.88	11.6	2.52	**2.7**	27.04	**25.0**	60	40
G. M. Williams Co., New London	30.00								
W. B. Martin, Rockville	**30.00**	26.74	12.2	3.92	**2.0**	24.01	**15.5**	35	65
Scofield & Miller, Stamford	30.00	25.55	13.5	2.46	**2.5**	26.16	**23.0**	53	47
The J. A. Lewis Estate, Willimantic	28.00								
	29.00								
A. W. Hutchinson, Gilead	**30.00**	26.00	15.4	3.39	**3.2**	23.67	**23.0**	47	53
Manufacturer	30.00	24.98	16.1	4.30	**2.5**	18.61	**20.0**	46	54
H T. Child, Woodstock*	28.00								
	29.00								
Manufacturer	**30.00**	25.61	17.1	4.44	....	19.18	....	44	56
F. Hallock & Co., Derby	**30.00**	25.01	20.0	2.65	**2.9**	24.52	**20.0**	54	46
Manufacturer	**28.00**	23.22	20.6	3.86	....	20.35	....	23	77
Manufacturer	**35.00**	28.61	22.3	3.90	**3.8**	24.75	**24.7**	52	48
F. T. Blish Hdw. Co., So. Manchester	34.00								
F. T. Blish Hdw. Co., So. Manchester	**32.00**	25.60	25.0	4.13	**3.5**	22.07	**22.0**	30	70
Manufacturer	32.00								
Manufacturer	**30.00**	23.92	25.4	4.17	....	20.93	....	17	83
Manufacturer	**28.00**	21.81	28.4	3.82	**4.0**	20.69	**20.0**	3	97
T. H. Eldredge, Norwich	**30.00**	23.30	28.8	2.45	**2.5**	20.51	**20.0**	81	19
The J. A. Lewis Estate, Willimantic	**28.00**	21.55	29.9	2.80	**2.5**	19.84	**18.0**	45	55
Bowker's Branch, Southport	28.00								
Harry Jackson, Wilton*	20.00	25.64	22.0†	1.01	....	31.90	...	56	44
Geo. W. Clark, Milford*	25.00	25.71	2.8†	3.82	**3.7**	23.03	**24.6**	34	66
W. I. Stevens & Son, Hockanum*	34.00	32.55	4.5	5.00	**4.1**	24.40	**20.0**	63	37

* Purchaser. † Valuation exceeds cost.

PERCENTAGE COMPOSITION AND

Station No.	Manufacturer.	Sampled from stock of
	Sampled by Station Agents.	
10039	American Agricultural Chemical Co., New York	J. G. Schwink
10014		Conn. School for Boys, Meriden
9795	Lowell Fertilizer Co., Boston, Mass.	Andrew Ure, Highwood
9968		S. D. Woodruff & Sons, Orange
	Sampled by Purchasers.	
10150	L. H. Hemingway, North Haven	P. K. Hoadley, Guilford
10078	Sanderson Fertilizer & Chemical Co., New Haven	Robert B. Fowler, R. D. 2, Guilford
10041	E. Frank Coe Co., New York	Wm. O. Burr, Fairfield
10868	Connecticut Fat Rendering & Fertilizer Corp., New Haven	E. E. Burwell, New Haven
10884	Connecticut Fat Rendering & Fertilizer Corp., New Haven	E. B. Clark, Milford

9771. Sold by Bowker Fertilizer Co., New York. Stock of M. J. Daly, Bolton. Sampled and sent by R. E. Buell, Gilead.

Regarding sample **10267,** Wilcox's Dry Ground Fish Guano, the manufacturers stated that the amount of phosphoric acid found was less by about 1 per cent. than had been found in the same brand in previous years, and that in their opinion the analysis did not fairly represent the average quality of this brand. The Station endeavored to draw other samples after receiving this protest, but was unable to do so.

The two samples, **9746** and **10284,** sold by the Bowker Co., are low grade, containing less than 7 per cent. of nitrogen, but the full amount nevertheless that is guaranteed. The price charged seems to be the same as for fish of the usual grade.

The commercial fertilizers described in preceding pages are raw materials, being for the most part manufacturing by-products which are dried, ground and sold without further preparation to fertilizer factories. They are some of the materials which are mixed in the factory to make the "Complete Manures"

VALUATION OF TANKAGE.

Station No.	Dealer's cash price per ton.	Valuation per ton.	Percentage difference between cost and valuation.	Chemical Analysis.				Mechanical Analysis.	
				Nitrogen.		Phosphoric acid.		Finer than 1-50 inch.	Coarser than 1-50 inch.
				Found.	Guaranteed.	Found.	Guaranteed.		
10039	$27.50	$26.43	4.0	5.59	....	15.10	....	49	51
10014	27.50	25.36	8.4	5.35	....	15.22	....	43	57
9795	30.00	25.82	16.2	4.81	4.1	17.64	15.0	47	53
9968	.....	20.23	....	5.49	5.8	7.75	....	37	63
10150	20.00	24.79	19.3*	5.75	4.9	14.67	....	27	73
10078	30.00	29.81	0.6	6.88	5.8	11.76	10.0	73	27
10041	33.00	29.33	12.5	8.49	7.4	7.98	11.0	45	55
10868	.....	....	....	3.99	....	21.43	....	29	71
10884	.....	....	....	4.00	....	21.31	....	..	..

* Valuation exceeds cost.

or "Special Manures" of the fertilizer trade. They are also the materials which are bought by many farmers for use, either singly or mixed together, on the farm.

MIXED FERTILIZERS.

BONE AND POTASH.

(Analyses on page 44.)

Several makers of fertilizers formerly sold, under this brand, mixtures of fine ground bone and muriate of potash, which were favorite fertilizers for top dressing grass land.

In previous reports these brands have been separately tabulated, as they are here.

Hereafter, however, they will be noticed with the other nitrogenous superphosphates, as it is evident that most of the brands at present are "bone and potash" only in name and not in substance.

10113. Darling's Dissolved Bone and Potash. Made by the American Agricultural Chemical Co. Stock of J. A. Lewis' Estate, Willimantic; J. S. Warner, Glastonbury; A. R. Manning & Co., Yantic.

PERCENTAGE COMPOSITION AND VALUATION OF DRY FISH.

	Bowker's.	Russia Cement Co.'s.	Am. Ag'l. Chem. Co.'s.	Wilcox's.†	Am. Ag'l. Chem. Co.'s.	Sanderson's.	Am. Ag'l. Chem. Co.'s.	Bowker's.	Bowker's.	Bowker's.
	10283	**10245**	**10169**	**10267**	**9933**	**10268**	**10070**	**9746**	**10284**	**9771**
Nitrogen as ammonia	0.10	0.08	0.11	0.29	0.18	0.49	0.10	0.20	0.66	....
Organic nitrogen	8.73	8.15	8.44	8.49	8.04	7.97	8.24	6.76	5.85	....
Total nitrogen found	8.83	8.23	8.55	8.78	8.22	8.46	8.34	6.96	6.51	8.39
" " guaranteed	**8.00**	**8.00**	**8.27**	**8.50**	**8.27**	**8.24**	**8.24**	**6.59**	**6.59**	....
Soluble phosphoric acid	0.50	0.64	0.50	0.70	0.61	0.43	0.48	0 54	0.88	....
Reverted " "	5.73	8.08	4.78	3.98	4.85	5.94	4.47	4.30	4.15	....
Insoluble " "	4.64	5.17	1.69	1.86	1.23	1.59	1.82	0.46	1.97	....
Total phosphoric acid found	10.87	13.89	6.97	6.54	6.69	7.96	6.77	5.30	7.00	....
" " " guaranteed	**6.00**	**11.00**	**7.00**	**6.00**	**7.00**	**6.00**	....	**5.00**	**6.00**	....
Cost per ton	$36.00	37.00	34.00	35.00	34.00	36.00	35.00	34.00	35.00	35.00
Valuation per ton	36.92	37.10	34.04	34.44	32.89	34.60	33.11	27.79	27.10	....
Percentage difference between cost and valuation	2.5*	0.3*	0.1*	1.6	3.4	4.0	5.7	22.3	29.1	....

* Valuation exceeds cost.

† See notice on page 40.

10280. Armour's Ammoniated Bone with Potash. Made by Armour Fertilizer Works, Baltimore. Stock of J. M. Young & Co., Norwich; E. A. Buck & Co., Willimantic; F. C. Benjamin & Co., Danbury.

10258. Swift's Lowell Dissolved Bone and Potash. Made by Swift's Lowell Fertilizer Co., Boston. Stock of E. E. Burwell, New Haven, and of F. S. Bidwell & Co., Windsor Locks.

10530. Lister's Animal Bone and Potash. Made by Lister's Agricultural Chemical Works, Newark, N. J. Stock of A. I. Martin, Wallingford.

10315. Ammoniated Bone and Potash. Made by Ohio Farmers Fertilizer Co., Columbus, O. Stock of R. B. Witter, Brooklyn, and of G. D. Bates, Putnam.

10255. Bowker's Square Brand Bone and Potash. Made by Bowker Fertilizer Co., New York. Stock of Norwalk Coal Co., Norwalk; Bowker Branch, Southport; C. W. and T. F. Atwood, Watertown.

NITROGENOUS SUPERPHOSPHATES AND GUANOS.

Here are included those mixed fertilizers containing nitrogen, phosphoric acid and, in most cases, potash, which are not designed by their manufacturers for use on any special crop. "Special Manures" are noticed further on.

1. *Samples Drawn by the Station Agent.*

In the table of analyses, pages 50 to 63, are given analyses of eighty-four samples belonging to this class, arranged according to the percentage difference between cost and valuation.

GUARANTEES.

Of the eighty-four analyses of nitrogenous superphosphates given in the table, twenty-one, one-fourth of the whole number, are below the manufacturer's minimum guarantee in respect of one or more ingredients, four are deficient in two ingredients, the others in one. In six cases there is a deficiency of nitrogen; in fifteen cases, of phosphoric acid and in four cases, of potash.

The brands which thus fail to fully meet the claims made for them, as regards composition, are as follows:

10303. Conn. Valley Orchard Co.'s High Grade Fertilizer. Total phosphoric acid found 9.75, guaranteed 11.0.

10223. Armour's Blood, Bone and Potash. Total phosphoric acid found 9.06, guaranteed 10.0.

ANALYSES AND VALUATIONS OF BONE AND POTASH.

	Darling's.	Armour's.	Swift's Lowell.	Lister's.	Ohio Farmers'.	Bowker's.
Percentage amounts of	**10113**	**10280**	**10258**	**10530**	**10315**	**10255**
Nitrogen in nitrates	0.27	0.68	....	....	0.06	....
" " ammonia	0.08	....	0.13	....	....	0.15
" organic	2.04	1.77	1.71	....	0.93	1.49
Total nitrogen found	2.39	2.45	1.84	....	0.99	1.64
Nitrogen guaranteed	**2.5**	**2.5**	**1.7**	....	**0.8**	**1.7**
Soluble phosphoric acid	5.12	4.64	5.73	6.00	3.81	3.81
Reverted "	3.35	2.13	3.21	3.48	5.20	3.68
Insoluble "	0.84	1.67	1.45	0.78	1.76	2.54
Total " found	9.31	8.44	10.39	10.26	10.77	10.03
" " guaranteed	**7.0**	....	**10.0**	**10.0**	**10.0**	**7.0**
Available " found	8.47	6.77	8.94	9.48	9.01	7.49
" " guaranteed	**6.0**	**6.0**	**9.0**	**10.0**	**8.0**	**6.0**
Potash found	10.21	2.25	2.12	4.45	3.82	2.19
" guaranteed	**10.0**	**2.0**	**2.0**	**2.0**	**4.0**	**2.0**
Cost per ton	$34.00	28.00	28.00	21.00	26 00	29.00
Valuation per ton	$24.34	16.52	16.38	12.27	14.88	14.85
Percentage difference	39.7	69.5	70.9	71.1	74.7	95.3

10558. Berkshire Complete Fertilizer.* Total phosphoric acid found 8.55, guaranteed 10.0. Available phosphoric acid found 7.55, guaranteed 8.0.

10208. Coe's Red Brand Excelsior Guano. Nitrogen found 3.18, guaranteed 3.3.

10559. Berkshire Complete Fertilizer.* Total phosphoric acid found 8.79, guaranteed 10.0.

10260. Ludlam's Cecrops or Dragon's Tooth. Potash found 6.78, guaranteed 7.0.

10201. Russia Cement Co.'s Essex Lawn Dressing. Available phosphoric acid found 4.85, guaranteed 6.0.

10308. Mapes' Top Dresser Improved. Full Strength.* Nitrogen found 8.46, guaranteed 10.0. Total phosphoric acid found 7.27, guaranteed 8.0.

10285. Mapes' Average Soils Complete Manure. Available phosphoric acid found 6.44, guaranteed 7.0.

10197. American Farmers' Market Garden Special. Nitrogen found 3.19, guaranteed 3.3.

10205. National Fertilizer Co.'s Chittenden's Complete. Total phosphoric acid found 9.80, guaranteed 10.0.

10525. Bowker's Middlesex Special. Potash found 5.74, guaranteed 6.0.

10209. E. F. Coe's Long Islander Market Garden Special. Nitrogen found 2.90, guaranteed 3.3.

10045. Russia Cement Co.'s Essex Fish and Potash. Available phosphoric found 8.84, guaranteed 9.0.

10193. Sanderson's Special with 10 per cent. Potash. Total phosphoric acid found 7.96, guaranteed 9.0. Potash found 9.42, guaranteed 10.0.

10261. Mapes' Complete A brand. Available phosphoric acid found 9.30, guaranteed 10.0.

10118. Church's Fish and Potash. Nitrogen found 1.87, guaranteed 2.1.

10101. Mapes' Top-Dresser Improved. Half Strength. Nitrogen found 4.46, guaranteed 4.9.

10237. Russia Cement Co.'s Essex A 1. Superphosphate. Available phosphoric acid found 6.64, guaranteed 7.0.

10281. Berkshire Ammoniated Bone Superphosphate. Total phosphoric acid found 9.12, guaranteed 10.0. Available phosphoric acid found 7.73, guaranteed 8.0.

10321. Packer's Union Universal Phosphate. Potash found 3.30, guaranteed 4.0.

In some of these cases at least, a deficiency of one ingredient is accompanied by a very considerable excess of another; these discrepancies being largely explained by imperfect mixing of the raw materials at the factory.

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* See Special notice, p. 46.

Analyses requiring Special Notice.

Berkshire Complete Fertilizer. An analysis, **10226**, not given in the table, is given below, which was made on a mixture of three samples, drawn from stock of the following dealers: Berkshire Fertilizer Co., Bridgeport; S. L. Bronson, Cheshire, and Johnson Bros., Jewett City.

The manufacturers, on receiving the analysis, stated that none of this brand had been shipped to Johnson Bros. this year, and that our analysis must, therefore, represent a mixture of two brands and not the complete. The samples drawn at the places above named were therefore separately analyzed and the two, **10558** and **10559**, which are unquestionably Berkshire Complete, are given in the tables, on pages 50 and 52. The original analysis, made on a mixture of the three samples, **10226**, and also the analysis of the sample from Johnson Bros., **10557**, are given below with **10558** and **10559**, for comparison.

	Mixture of the three samples.	From Manufacturers.	From Bronson.	From Johnson Bros.	Average of the three.
	10226	10558	10559	10557	....
Total nitrogen	2.85	3.08	2.70	2.80	2.86
Available phosphoric acid	7.92	7.55	7.91	7.83	7.76
Total phosphoric acid	8.72	8.55	8.79	8.60	8.65
Potash	6.63	6.54	6.80	6.59	6.64

The separate analyses show that the material sampled from Johnson Bros. had the same composition as the Berkshire Complete, and the average of the three single analyses agrees perfectly with the single analysis made on a mixture of the three samples.

It is claimed by the manufacturer that the analysis of Mapes' Top Dresser Improved, Full Strength, **10308**, given on pages 54 and 55, does not represent the mixture in the right proportions; in that the percentage of nitrogen is very considerably lower and that of potash considerably higher than the formula, by which it was made, calls for. An effort was made to secure another sample for analysis, but without success.

10166. Packers' Union Gardeners' Complete Manure, pages 50 and 51, contains nearly three per cent. more of nitrogen than is guaranteed and two per cent. more than either of the other two samples of this brand, **10865** and **10866**, whose analyses appear in the table, pages 50 and 51.

COST AND VALUATION.

Cost.

The method used to ascertain the retail cash cost price of the superphosphates is as follows:

The sampling agents inquire and note the price at the time each sample is drawn. The analysis, when done, is reported to each dealer from whom a sample was taken, as well as to the manufacturer of the article, in order to give opportunity for explanation or correction as regards the price or the analysis itself. When the data thus gathered show a wide range of prices, further correspondence is required and the manufacturers are also consulted.

From the data thus obtained the average prices are computed.

Valuation.

The valuation has been computed in all cases in the usual manner, as explaiued on page 15.

Percentage difference given in the table shows the precentage excess of the cost price over the average retail cost, at freight centers, of the nitrogen, phosphoric acid and potash contained in the fertilizer.

This information helps the purchaser to estimate the comparative value of different brands and to determine whether it is better economy to buy the commercial mixed fertilizers, of which so many are now offered for sale, or to purchase and mix for himself the raw materials.

Which plan is preferable can only be determined by each individual farmer, who should know best what his soil and crops need and what his facilities for purchase and payment are.

In case a fertilizer has sold at widely different prices, the *manufacturer's price,* when known, has been used in calculating percentage difference.

Otherwise an *average,* or *nearly average price,* forms the basis of comparison between cost and valuation. The price thus employed is printed in heavy-faced type.

The average cost of the superphosphates is $30.39 per ton, the average valuation is $21.10 and the average percentage difference 44.0.

Last year the corresponding figures were:—Average cost, $30.14; average valuation, $21.19; percentage difference, 42.2.

These valuations, it must be remembered, are based on the assumption that the nitrogen, phosphoric acid and potash in each fertilizer are of good quality and readily available to farm crops. Chemical examination shows conclusively whether this is true in respect of potash and phosphoric acid.

The average percentage composition of these 84 nitrogenous superphosphates, excluding Peruvian Guano and another brand, not now on the market, is:

Nitrogen	2.75
Available phosphoric acid	8.12
Potash	4.53
Cost	$30.39

How wide a range of composition there is in these 84 fertilizers and how widely different the cost of plant food in them is, may be seen from the following statement of the average amounts of nitrogen, phosphoric acid and potash which are purchasable for $30.00 spent in these factory mixed goods.

For $30.00 the following numbers of pounds of nitrogen, phosphoric acid and potash may be purchased:

	Average cost per ton.	Nitrogen, pounds.	Available phosphoric acid, pounds.	Potash, pounds.
In the first 14 samples in the table	$29.90	70	170	130
In the next following 12 samples in the table	31.75	64	164	101
" " 10 " "	34.20	67	125	100
" " 13 " "	31.00	54	152	96
" " 13 " "	29.70	44	174	68
" " 8 " "	28.25	43	157	55
" " 12 " "	27.33	27	179	51

These figures, which are totally independent of the Station's valuation, being taken directly from the chemical analyses and the selling prices, show first, that those fertilizers which stand nearest the beginning of the tables of analyses, and, therefore, those in which the valuation and the cost most nearly coincide, are the ones in which can be bought the most plant food for a given sum.

These figures also show that *as a rule* in fertilizers sold at the lowest prices ("cheap fertilizers"), the plant food actually costs more than in higher priced fertilizers.

For instance, for $30.00 there could be bought in the fifteen fertilizers which had the highest average selling price, $34.20, two and a half times as much nitrogen, twice as much potash and two-thirds as much phosphoric acid as could be bought for $30.00 in twelve other fertilizers whose average selling price was lowest, $27.33. The farmer, who buys plant food in these low priced goods, is spending twice as much for his fertilizers as he needs to spend. These figures are averages of groups of fertilizers. If single fertilizers were discussed, the comparison would be much more striking.

Regarding the availability of the nitrogen, there is no reason to believe that the nitrogen in the high-priced superphosphates is inferior in quality to that in the lower priced mixtures. Inferior stock or inferior work is more likely to be found in "cheap goods."

It is amazing that anyone can be found who will buy fertilizers having a composition such as is guaranteed for some of those found in the tables below. It is not difficult to find brands in this table which contain three times as much nitrogen and potash, and as much phosphoric acid as other brands which sell for the same price.

There is no fraud in the matter. The composition of the low grade fertilizers corresponds fairly well with the guarantees, and if purchasers can be found who will pay for a ton of plant food as much as would suffice to purchase three or four tons, the seller is not breaking the law in taking advantage of their obtuseness.

The average composition and cost of nitrogenous superphosphates for a number of years have been as follows:

PERCENTAGE COMPOSITION.

Year.	Nitrogen.	Available phosphoric acid.	Potash.	Cost. per ton.
1903	2.75	8.12	4.53	$30.39
1902	2.51	8.69	4.44	30.14
1901	2.52	8.77	4.48	28.43
1900	2.48	8.77	4.54	30.00

2. *Sampled by Purchasers.*

On pages 62 and 63 are tabulated analyses of five samples of guanos and nitrogenous superphosphates which were sent by interested persons to the Station for analysis. The Station assumes no direct responsibility for the sampling of these articles.

NITROGENOUS SUPERPHOSPHATES.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	1. *Sampled by Station Agent.*				
10166	Packers' Union Gardeners' Complete Manure*	American Agricultural Chemical Co., New York	T. A. Tillinghast, Brooklyn	$34.00	$35.28
10305	Bone, Fish and Potash	E. R. Kelsey, Branford	Loomis Bros., Granby	25.00	22.71
			J. E. Towner,‡ Branford	22.00	
10221	A. A. C. Co.'s XX Special Formula	Amer. Ag. Chemical Co., N. Y.	C. Buckingham, Southport	31.00	27.58
10303	Complete H. G. Fertilizer	Conn. Valley Orchard Co., Berlin	Manufacturer	25.00	21.69
10866	Packers' Union Gardeners' Complete Manure*	American Agricultural Chemical Co., New York	F. M. Loomis, North Granby	34.00	28.67
10211	Manchester's Formula	E. Manchester & Sons, West Winsted	Manufacturer	31.00	26.12
10033	Special Formula	Bowker Fertilizer Co., New York	M. A. Fitzgerald‡ Stratford	30.00	25.02
10223	Armour's Bone, Blood and Potash	Armour Fertilizer Works, Baltimore	R. H. Hall, East Hampton	36.00	28.80
			Daniels' Mill Co., Hartford	35.00	
				35.50	
10114	Darling's Blood, Bone and Potash	American Agricultural Chemical Co., New York	The J. A. Lewis Estate, Willimantic	34.00	28.77
			M. D. Stanley, New Britain	37.00	
				35.50	
10224	Famous Gold Brand Excelsior Guano*	E. Frank Coe Co., New York	Joseph Adams,‡ Westport	29.00	23.39
10865	Packers' Union Gardeners' Complete Manure*	American Agricultural Chemical Co., New York	R. M. Fenn, Middlebury	34.00	27.38
10558	Berkshire Complete Fertilizer*	Berkshire Fertilizer Co., Bridgeport	Manufacturer	28.00	22.53
10208	Coe's Red Brand Excelsior Guano	E. Frank Coe Co., New York	A. L. Burdick, Westbrook	34.00	25.85
			Joseph Adams,‡ Westport	31.00	
				32.50	
10264	E. Frank Coe's Fish and Potash, F. P. Brand	E. Frank Coe Co., New York	S. V. Osborn, Branford	23.00	18.26
			A. L. Burdick, Westbrook	24.00	
			F. H. Rolf, Guilford	23.00	
10204	Nassau Practical	Nassau Fertilizer Co., New York	C. Buckingham, Southport	30.00	23.77
10314	Wheeler's Superior Truck Fertilizer	American Agricultural Chemical Co., New York	John Luby, Burlington	33.00	25.95
			H. E. Cleveland, East Winsted	34.00	

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* See special notice, page 46.

‡ Valuation exceeds cost.

ANALYSES AND VALUATIONS.

		NITROGEN.					PHOSPHORIC ACID.							POTASH.		
					Total Nitrogen.					Total.		Available.		Found.		
Station No.	Percentage difference between cost and valuation.	Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen Organic.	Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	Guaranteed.
10166	3.6‡	0.07	3.50	1.85	5.42	2.5	4.83	2.65	1.35	8.83	7.0	7.48	6.0	2.71	9.93	10.0
10305	3.1‡	---	0.58	2.83	3.41	2.5	3.98	3.02	0.50	7.50	4.0	7.00	----	0.78	4.98	4.0
10221	12.4	---	1.50	2.50	4.00	4.1	5.42	2.23	2.03	9.68	8.0	7.65	7.0	7.48	7.48	7.0
10303	15.3	0.28	0.46	2.15	2.89	2.5	7.40	1.72	0.63	9.75	11.0	9.12	9.0	4.28	4.28	4.0
10866	18.6	---	0.46	2.94	3.40	2.5	6.18	1.64	0.89	8.71	7.0	7.82	6.0	1.30	10.02	10.0
10211	18.7	0.83	0.13	2.62	3.58	3.4	5.52	3.09	1.00	9.61	.....	8.61	7.5	5.14	7.19	5.0
10033	19.9	0.81	0 70	1.77	3.28	3.3	4.69	3.85	2.13	10.67	8.0	8.54	....	7.02	7.02	7.0
10223	23.3	1.32	---	3.03	4.35	4.1	7.81	1.06	0.19	9.06	10.0	8.87	8.0	7.74	7.74	7.0
10114	23.4	1.30	0.10	2.86	4.26	4.1	5.31	4.52	0.62	10.45	8.0	9.83	7.0	7.24	7.24	7.0
10224	24.0	---	1.02	1.66	2.68	2.5	6.69	2.12	1.25	10.06	....	8.81	8.0	0.76	6.07	6.0
10865	24.2	---	0.42	2.93	3.35	2.5	4.59	2.96	0.88	8.43	7.0	7.55	6.0	10.71	10.71	10.0
10558	24.3	1.12	---	1.96	3.08	2.5	5.12	2.43	1.00	8.55	10.0	7.55	8.0	6.54	6.54	6.0
10208	25.7	---	1.46	1.72	3.18	3.3	7.82	1.95	1.07	10.84	10.0	9.77	9.0	0.78	5.98	6.0
10264	25.9	---	---	2.50	2.50	2.0	5.01	2.67	2.68	10.36	7.0	7.68	6.0	2.40	2.40	2.0
10204	26.2	---	0.91	1.96	2.87	2.5	6.28	1.97	2.20	10.45	9.0	8.25	8.0	6.83	6.83	6.0
10314	27.1	0.50	0.44	2.53	3.47	3.3	7.74	1.46	0.59	9.79	9.0	9.20	8.0	6.97	6.97	7.0

‡ Not a dealer.

NITROGENOUS SUPERPHOSPHATES

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	1. *Sampled by Station Agent.*				
10559	Berkshire Complete Fertilizer*	Berkshire Fertilizer Co., Bridgeport	S. L. Bronson, Cheshire	$28.00	$21.76
10103	Mapes' Vegetable Manure, or complete for light soils	Mapes F. & P. G. Co., New York	Mapes' Branch, Hartford	40.00	30.95
			A. N. Clark, Milford	40.00	
10311	Great Eastern Garden Special	Amer. Ag. Chem. Co., New York	J. B. Shekleton, East Killingly	34.00	26.25
10313	Williams & Clark's H. G. Special	Amer. Ag. Chem. Co., New York	W. H. Chappell, Chesterfield	34.00	26.17
10304	Swift-Sure Superphosphate for general use	M. L. Shoemaker & Co., Philadelphia	F. H. Rolf, Guilford	33.00	25.66
			Olds & Whipple, Hartford	34.00	
			E. B. Clark Co., Milford	33.00	
			Spencer Bros., Suffield	34.00	
				33.50	
10234	American Farmers' Ammoniated Bone Brand	American Farmers' Fertilizer Co., New York City	S. V. Osborn, Branford	28.00	20.25
			H. A. Bugbee, Willimantic	25.00	
				26.50	
10289	Wilcox' High Grade Fish and Potash	Wilcox Fertilizer Works, Mystic	W. A. Howard, Woodstock	28.00	21.58
			Manufacturer	29.00	
			C. G. Fitch, Jewett City	....	
				28.50	
10260	Cecrops or Dragon's Tooth	Frederick Ludlam, New York	S. A. Smith, Clintonville	34.00	25.71
10526	Listers' Pure Bone Superphosphate of Lime	Listers' Agricultural Chemical Works, Newark, N. J.	A. I. Martin, Wallingford	30.00	22.56
10531	Mapes' Dissolved Bone	Mapes F. & P. G. Co., New York	E. F. Strong, Colchester	31.00	22.76
			Mapes' Branch, Hartford	30.00	
				30.50	
10183	Complete Manure with 10% Potash	Amer. Ag. Chem. Co., New York	D. B. Wilson Co., Waterbury	38.00	26.82
			Carlos Bradley, Ellington	34.00	
				36.00	
10292	Wilcox' Fish and Potash	Wilcox Fertilizer Works, Mystic	Waldo Tillinghast, Plainfield	25.00	19.34
			I. W. Dennison, Mystic	22.00	
			Olds & Whipple, Hartford	29.00	
				26.00	

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* See special notice, page 46.

ANALYSES AND VALUATIONS—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid.							Potash.		
					Total Nitrogen.					Total.		Available.		Found.		
		Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen Organic.	Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	Guaranteed.
10559	28.7	1.03	---	1.67	2.70	2.5	5.25	2.66	0.88	8.79	10.0	7.91	8.0	6.80	6.80	6.0
10103	29.2	4.05	0.16	1.41	5.62	4.9	2.24	4.07	2.89	9.20	8.0	6.31	6.0	1.57	7.24	6.0
10311	29.5	1.51	0.06	1.89	3.46	3.3	4.69	4.24	2.20	11.13	9.0	8.93	8.0	7.75	7.75	7.0
10313	29.9	1.55	0.04	2.10	3.69	3.3	4.91	3.52	2.07	10.50	9.0	8.43	8.0	7.26	7.26	7.0
10304	30.6	0.84	---	2.09	2.93	2.8	8.53	3.48	2.63	14.64	----	12.01	----	0.60	4.61	4.5
10234	30.9	---	0.82	2.03	2.85	2.0	6.58	2.16	1.42	10.16	9.5	8.74	8.0	0.57	2.35	2.0
10289	32.1	---	0.29	3.17	3.46	3.3	3.69	2.24	1.21	7.14	6.0	5.93	----	4.93	4.93	4.0
10260	32.2	0.35	0.60	2.67	3.62	3.3	6.80	1.54	0.93	9.27	9.0	8.34	7.0	6.78	6.78	7.0
10526	33.0	---	0.74	2.25	2.99	2.5	8.91	1.78	1.04	11.73	11.0	10.69	9.0	0.44	2.53	2.0
10531	34.0	---	0.15	2.65	2.80	2.1	4.53	9.28	4.29	18.10	----	13.81	12.0	----	----	----
10183	34.2	1.17	0.11	2.20	3.48	3.3	4.21	3.01	1.48	8.70	7.0	7.22	6.0	10.18	10.18	10.0
10292	34.4	---	0.23	2.73	2.96	2.5	1.82	3.89	3.41	9.12	6.0	5.71	5.0	3.69	3.69	3.0

NITROGENOUS SUPERPHOSPHATES.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	1. *Sampled by Station Agent.*				
10111	Quinnipiac Market Garden Manure	Amer. Ag. Chem. Co., New York	C. Buckingham, Southport	$31.00	$25.82
			G. M. Williams Co., New London	36.00 35.00	
10201	Essex Lawn Dressing	Russia Cement Co., Gloucester, Mass.	W. J. Cox, East Hartford	40.00	29.41
10308	Mapes' Top Dresser,* Improved, full strength	Mapes F. & P. G. Co., New York	R. H. Hall, East Hampton	48.00	35.22
			Mapes' Branch, Hartford	48.00	
10285	Mapes' Average Soils Complete Manure	Mapes F. & P. G. Co., New York	Mapes' Branch, Hartford	34.00	24.93
			Manchester Elevator Co., Manchester	34.00	
10024	Formula A	Sanderson Fertilizer & Chemical Co., New Haven	D. L. Brockett, Suffield	33.00	24.19
			Geo. W. Eaton, Plainville	35.00	
			E. B. Clark Co., Milford	33.00	
10197	American Farmers' Market Garden Special	American Farmers' Fertilizer Co., New York	H. T. Childs,† Woodstock	....	24.70
			E. F. Strong, Colchester	34.00	
			S. V. Osborn, Branford	35.00	
10029	Bowker's Fisherman's Brand Fish and Potash	Bowker Fertilizer Co., New York	Wilson & Burr, Middletown	26.00	18.00
			D. B. Wilson Co., Waterbury	25.00	
10205	Chittenden's Complete Fertilizer	National Fertilizer Co., Bridgeport	G. A. & H. B. Williams, E. Hartford	37.00	25.09
			F. Hallock & Co., Derby	33.00	
			W. H. Mansfield,† West Hartford	36.00 35.00	
10236	Wilcox' Complete Bone Superphosphate	Wilcox Fertilizer Works, Mystic	Manufacturer	28.00	19.94
			W. A. Howard, Woodstock	28.00	
			C. G. Fitch, Jewett City	....	
10286	Chittenden's Fish and Potash	National Fertilizer Co., Bridgeport	Joseph Myers, Windsor Locks	29.00	21.18
			A. H. Cashen, Meriden	30.00	
			G. A. & H. B. Williams, E. Hartford	32.00	

* See special notice, page 46.

† Not a dealer.

ANALYSES AND VALUATIONS—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid.							Potash.		
		Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen Organic.	Total Nitrogen.		Soluble.	Reverted.	Insoluble.	Total.		Available.		Found.		Guaranteed.
					Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	
10111	35.5	1.17	---	2.29	3.46	**3.3**	5.28	3.58	1.90	10.76	**9.0**	8.86	**8.0**	7.24	7.24	**7.0**
10201	36.0	0.03	4.05	0.03	4.11	**3.7**	0.67	4.18	6.19	11.04	**7.0**	4.85	**6.0**	0.15	8.64	**7.0**
10308	36.3	7.78	0.26	0.42	8.46	**10.0**	1.47	3.11	2.69	7.27	**8.0**	4.58	----	1.24	4.84	**4.0**
10285	36.4	2.71	0.25	1.39	4.35	**4.1**	3.20	3.24	1.73	8.17	**8.0**	6.44	**7.0**	1.25	5.22	**5.0**
10024	36.4	0.42	---	2.99	3.41	**3.3**	5.02	2.62	1.95	9.59	**9.0**	7.64	**6.0**	6.31	6.31	**6.0**
10197	37.7	---	0.69	2.50	3.19	**3.3**	6.42	1.70	1.60	9.72	**9.5**	8.12	**8.0**	6.26	6.94	**7.0**
10029	38.9	---	0.18	2.37	2.55	**2.5**	3.22	2.99	1.66	7.87	**5.0**	6.21	**4.0**	3.95	3.95	**4.0**
10205	39.5	0.45	0.62	2.40	3.47	**3.3**	6.64	1.83	1.33	9.80	**10.0**	8.47	**8.0**	6.40	6.40	**6.0**
10236	40.4	0.31	0.12	1.91	2.34	**2.1**	4.38	4.32	4.25	12.95	**9.0**	8.70	----	3.53	3.53	**3.0**
0286	41.6	---	---	2.99	2.99	**3.0**	4.59	2.76	2.51	9.86	**6.0**	7.35	----	2.94	4.11	**4.0**

NITROGENOUS SUPERPHOSPHATES.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	1. *Sampled by Station Agent.*				
10317	Fish and Potash	Rogers Mfg. Co., Rockfall	E. F. Strong, Colchester	$29.00	$20.25
			Manufacturer	29.00	
			Rockville Milling Co., Rockville	29.00	
10525	Middlesex Special	Bowker Fertilizer Co., New York	August Grulich, Meriden	27.00	18.85
10243	Swift's Lowell Market Garden Manure	Swift's Lowell Fertilizer Co., Boston	Spencer Bros., Suffield	38.00	26.52
			D. W. Barnes, Windsor	......	
10295	Hubbard's All Soils, All Crops Phosphate	The Rogers & Hubbard Co., Middletown	J. M. Johnson, Woodstock	31.00	21.57
			Jos. Sarle, Dayville	......	
9993	Bowker's Market Garden Fertilizer	Bowker Fertilizer Co., New York	W. B. Martin, Rockville	35.00	23.61
			Bowker's Branch, Southport	34.00	
10296	O. & W. Special Phosphate	Olds & Whipple, Hartford	Manufacturer	34.00	23.56
10209	Long Islander Market Garden Special	E. Frank Coe Co., New York	W. L. & S. T. Merwin, Milford	34.00	23.40
10206	Chittenden's Market Garden Fertilizer	National Fertilizer Co., Bridgeport	Joseph Myers, Windsor Locks	31.00	22.01
			A. H. Cashen, Meriden	33.00	
				32.00	
10045	Essex Fish and Potash	Russia Cement Co., Gloucester, Mass.	W. J. Cox, East Hartford	30.00	20.28
			Spencer Bros., Suffield	31.00	
10300	Armour's All Soluble	Armour Fertilizer Works, Baltimore, Md.	R. H. Hall, East Hampton	32.00	21.60
			E. A. Buck & Co., Willimantic	32.00	
			Meriden Grain & Feed Co., Meriden	35.00	
10235	Wilcox's Special Superphosphate	Wilcox Fertilizer Works, Mystic	Manufacturer	23.00	15.39
			Waldo Tillinghast, Plainfield	22.00	
			C. G. Fitch, Jewett City	......	
10306	Swift's Lowell Animal Brand for all Crops	Swift's Lowell Fertilizer Co., Boston	Andrew Ure, Highwood	30.00	21.34
			S. W. Bray, Milford	32.00	
			Spencer Bros., Suffield	32.00	
10219	Lister's Success Fertilizer	Lister's Agric. Chem. Works, Newark, N. J.	D. C. Burnham, R. F. D., Colchester	26.00	17.74
			A. W. Hutchinson, Gilead	28.00	
				27.00	

ANALYSES AND VALUATIONS—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid.							Potash.		
					Total Nitrogen.					Total.		Available.		Found.		
		Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen Organic.	Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	Guaranteed.
10317	43.2	0.32	0.16	3.08	3.56	3.3	1.66	2.89	2.46	7.01	6.0	4.55	4.0	4.09	4.09	3.8
10525	43.2	0.47	0.12	2.25	2.84	2.1	2.75	1.81	1.41	5.97	5.0	4.56	4.0	5.74	5.74	6.0
10243	43.3	1.18	---	2.92	4.10	4.1	4.21	2.68	1.55	8.44	8.0	6.89	7.0	0.89	6.63	6.0
10295	43.7	0.94	---	1.30	2.24	2.3	7.94	4.12	1.41	13.47	12.0	12.06	10.0	3.90	3.90	3.0
9993	44.0	0.81	0.16	1.53	2.50	2.5	4.56	2.58	1.97	9.11	7.0	7.14	6.0	9.96	9.96	10.0
10296	44.3	0.64	---	3.54	4.18	4.1	none	3.69	3.91	7.60	4.0	3.69	----	1.24	5.28	3.3
10209	45.3	---	1.32	1.58	2.90	3.3	6.52	2.11	2.08	10.71	10.0	8.63	8.5	5.91	5.91	6.0
10206	45.4	0.50	---	2.02	2.52	2.5	5.97	2.47	1.68	10.12	9.0	8.44	8.0	6.61	6.61	6.0
10045	47.9	0.31	---	2.17	2.48	2.1	4.29	4.55	5.78	14.62	12.0	8.84	9.0	2.54	2.54	2.3
10300	48.1	1.07	---	2.10	3.17	2.9	6.38	2.27	0.55	9.20	----	8.65	8.0	4.08	4.08	4.0
10235	49.4	---	---	1.41	1.41	1.0	4.64	4.27	2.60	11.51	9.0	8.91	----	2.30	2.30	1.5
10306	50.0	0.07	---	2.63	2.70	2.5	5.57	3.56	1.76	10.89	10.0	9.13	9.0	4.27	4.27	4.0
10219	52.2	---	0.20	1.33	1.53	1.2	8.08	2.04	1.88	12.00	11.0	10.12	9.0	0.40	2.93	2.0

NITROGENOUS SUPERPHOSPHATES.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	1. *Sampled by Station Agent.*				
10193	Sanderson's Special, 10% Potash	Sanderson Fertilizer & Chemical Co., New Haven	Manufacturer	$35.00	$22.49
			R. H. Hall, East Hampton	35.00	
10278	Williams & Clark's Americus Ammoniated Bone Superphosphate	American Agricultural Chemical Co., New York City	D. B. Wilson Co., Waterbury	32.00	19.89
			R. H. Hall, East Hampton	30.00	
				31.00	
10116	Darling's Farm Favorite	American Ag. Chem. Co., New York	M. D. Stanley, New Britain	31.00	18.58
			A. R. Manning & Co., Yantic	29.00	
			T. E. Greene, Plainfield	29.00	
10261	Mapes' Complete Manure, A Brand	Mapes F. & P. G. Co., New York City	F. S. Bidwell & Co., Windsor Locks	34.00	21.33
			Mapes' Branch, Hartford	33.00	
				33.50	
10030	Bowker's Hill & Drill Phosphate	Bowker Fertilizer Co., New York City	C. W. & T. F. Atwood, Watertown	33.00	20.00
			Bowker's Branch, Southport	30.00	
				31.50	
10212	Cecrops Cereal Brand	Frederick Ludlam, New York	S. A. Smith, Clintonville	23.00	14.49
9997	Bradley's XL Superphosphate	American Ag. Chem. Co., N. Y.	F. S. Bidwell & Co., Windsor Locks	32.00	20.12
			Spencer Bros., Suffield	32.00	
			Scofield & Miller, Stamford	32.00	
9999	Quinnipiac Phosphate	American Ag. Chem. Co., N. Y.	Meeker Coal Co., Norwalk	32.00	20.05
			F. S. Bidwell & Co., Windsor Locks	32.00	
10120	Bradley's New Method Fertilizer	American Ag. Chem. Co., N. Y.	Spencer Bros., Suffield	30.00	18.60
10319	Great Eastern General Fertilizer	American Ag. Chem. Co., N. Y.	T. E. Greene, Plainfield	26.00	15.93
			J. B. Shekleton, East Killingly	26.00	
10112	East India A. A. Ammoniated Superphosphate	American Ag. Chem. Co., N. Y.	Edw. White, Rockville	32.00	20.22
			W. F. Andross, East Hartford	34.00	
				33.00	
10023	Luce Bros.' Bone, Fish and Potash	Sanderson Fertilizer & Chem. Co., New Haven	E. B. Clark Co., Milford	25.00	15.09
			Geo. W. Eaton, Plainville	25.00	
10272	Crocker's New Rival Fertilizer	American Ag. Chem. Co., N. Y.	F. M. Loomis, North Granby	25.00	15.06

ANALYSES AND VALUATIONS—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid.							Potash.		
					Total Nitrogen.					Total.		Available.		Found.		
		Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen Organic.	Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	Guaranteed.
10193	55.6	---	---	2.58	2.58	2.5	3.17	2.36	2.43	7.96	9.0	5.53	5.0	9.42	9.42	10.0
10278	55.9	0.30	0.10	2.14	2.54	2.5	6.72	3.27	2.12	12.11	11.0	9.99	9.0	2.17	2.17	2.0
10116	56.1	0.21	---	1.98	2.19	2.1	5.62	3.73	1.26	10.61	10.0	9.35	8.0	3.15	3.15	3.0
10261	57.1	1.10	0.13	1.55	2.78	2.5	3.12	6.18	3.80	13.10	12.0	9.30	10.0	3.56	3.56	2.5
10030	57.5	0.72	0.08	1.75	2.55	2.5	7.52	2.54	1.97	12.03	10.0	10.06	9.0	2.37	2.37	2.0
10212	58.7	---	---	1.24	1.24	0.8	6.50	2.98	2.35	11.83	10.0	9.48	8.0	1.29	1.29	1.0
9997	59.0	---	0.20	2.46	2.66	2.5	6.80	2.39	2.64	11.83	11.0	9.19	9.0	2.32	2.32	2.0
9999	59.6	---	0.18	2.47	2.65	2.5	6.75	2.32	2.74	11.81	11.0	9.07	9.0	2.33	2.33	2.0
10120	61.3	---	---	2.11	2.11	1.7	5.86	2.81	2.33	11.00	9.0	8.67	8.0	3.50	3.50	3.0
10319	63.2	0.03	---	1.19	1.22	0.8	3.97	4.21	3.53	11.71	10.0	8.18	8.0	4.05	4.05	4.0
10112	63.2	0.30	0.42	1.84	2.56	2.5	7.44	2.68	1.98	12.10	11.0	10.12	9.0	2.30	2.30	2.0
10023	65.7	---	0.26	1.64	1.90	1.7	2.43	1.65	3.52	7.60	6.0	4.08	4.0	4.33	4.33	4.0
10272	66.0	---	---	1.32	1.32	1.0	6.64	2.09	1.29	10.02	9.0	8.73	8.0	2.82	2.82	2.0

NITROGENOUS SUPERPHOSPHATES.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	1. *Sampled by Station Agent.*				
10259	Swift's Lowell Bone Fertilizer for Corn and Grain	Swift's Lowell Fertilizer Co., Boston	Spencer Bros., Suffield	$30.00	$16.77
			H. A. Bugbee, Willimantic	28.00	
9990	Bowker's Farm and Garden Phosphate or Ammoniated Dissolved Bone	Bowker Fertilizer Co., New York	E. B. Clark Co., Milford	23.00	16.74
			Hubbell & Bradley, Saugatuck	32.00	
				28.00	
10269	All Round Fertilizer	Rogers Mfg. Co., Rockfall	E. F. Strong, Colchester	27.00	16.51
			Manufacturer	28.00	
			Rockville Milling Co., Rockville	29.00	
10118	Church's Fish and Potash	American Ag. Chem. Co., N. Y.	J. & H. Woodford, Avon	27.00	15.21
			A. I. Martin, Wallingford	21.00	
				26.00	
10102	Mapes' Cereal Brand	Mapes F. & P. G. Co., New York	A. N. Clark, Milford	28.00	16.36
			E. F. Strong, Colchester	28.00	
10262	Chittenden's Ammoniated Bone Phosphate	National Fertilizer Co., Bridgeport	Geo. W. Eaton, Plainville	30.00	17.49
			G. A. & H. B. Williams, E. Hartford	30.00	
10101	Mapes' Top Dresser Improved, half strength	Mapes F. & P. G. Co., New York	Wilson & Burr, Middletown	31.00	18.47
			F. S. Bidwell & Co., Windsor Locks	33.00	
				32.00	
10277	Quinnipiac Climax Phosphate	American Ag. Chem. Co., N. Y.	J. P. Lathrop, Plainfield	26.00	14.93
10115	Darling's General Fertilizer	American Ag. Chem. Co., N. Y.	F. S. Bidwell & Co., Windsor Locks	28.00	15.27
			T. E. Greene, Plainfield	26.00	
				27.00	
10237	Essex A1 Superphosphate	Russia Cement Co., Gloucester, Mass.	E. F. Strong, Colchester	25.00	13.96
			Henry Davis, Durham Center	25.00	
10256	Gloucester Fish and Potash	Bowker Fertilizer Co., New York	Lightbourn & Pond Co., New Haven	24.00	13.34
10265	E. Frank Coe's H. G. Ammoniated Superphosphate	E. Frank Coe Co., New York	R. A. Hardin, Glastonbury	34.00	18.32
			J. R. Babcock, Old Mystic	32.00	
				33.00	

ANALYSES AND VALUATIONS—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid.							Potash.		
		Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen Organic.	Total Nitrogen.		Soluble.	Reverted.	Insoluble.	Total.		Available.		Found.		Guaranteed.
					Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	
10259	67.0	---	---	1.83	1.83	1.6	5.92	2.76	1.27	9.95	9.0	8.68	8.0	2.94	2.94	3.0
9990	67.3	0.16	0.22	1.36	1.74	1.7	6.86	2.36	1.58	10.80	9.0	9.22	8.0	2.56	2.56	2.0
10269	69.5	0.06	0.09	1.61	1.76	1.7	5.52	3.00	1.83	10.35	10.0	8.52	8.0	2.87	2.87	2.0
10118	70.9	---	---	1.87	1.87	2.1	3.97	1.88	3.03	8.88	7.0	5.85	6.0	3.02	3.02	2.0
10102	71.1	0.69	---	1.30	1.99	1.7	3.90	3.76	1.27	8.93	8.0	7.66	6.0	3.34	3.34	3.0
10262	71.5	---	---	2.10	2.10	1.8	6.10	2.45	1.65	10.20	10.0	8.55	8.0	2.64	2.64	2.0
10101	73.3	4.12	0.16	0.18	4.46	4.9	0.35	1.84	2.21	4.40	4.0	2.19	....	0.68	2.37	2.0
10277	74.1	---	---	1.38	1.38	1.0	4.99	3.56	3.05	11.60	10.0	8.55	8.0	1.98	1.98	2.0
10115	76.8	0.09	---	1.29	1.38	1.3	5.25	3.12	1.43	9.80	7.0	8.37	6.0	3.30	3.30	3.0
10237	79.1	---	---	1.22	1.22	1.0	2.37	4.27	5.68	12.32	9.0	6.64	7.0	2.34	2.34	2.0
10256	79.9	0.10	---	1.16	1.26	0.8	3.65	4.26	3.53	11.44	9.0	7.91	8.0	1.17	1.17	1.0
10265	80.1	---	0.28	1.81	2.09	1.9	7.33	2.06	1.56	10.95	10.0	9.39	9.0	0.58	2.41	2.3

NITROGENOUS SUPERPHOSPHATES.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	1. *Sampled by Station Agent.*				
10281	Berkshire Ammoniated Bone Phosphate	Berkshire Fertilizer Co., Bridgeport	Johnson Bros., Jewett City	$27.00	$14.79
			J. W. Palmer, Stamford	28.00	
			Manufacturer	26.00	
10321	Packers' Union Universal Phosphate	American Ag. Chem. Co., N. Y.	G. W. Eaton, Bristol	27.00	14.24
			F. L. Mackay, Ellington	27.00	
10162	Read's Standard Superphosphate	American Ag. Chem. Co. N. Y.	O. Russ, Mount Hope	29.00	15.28
			J. A. Nichols & Co., Danielson	30.00	
			L. A. Fenton, Norwich Town	29.00	
				29.50	
10263	Chittenden's Universal Phosphate	National Fertilizer Co., Bridgeport	G. W. Eaton, Plainville	25.00	12.74
			A. H. Cashen, Meriden	25.00	
10119	Bradley's Eclipse Phosphate	American Ag. Chem. Co., N. Y.	Phineas Platt, Milford	29.00	14.38
			J. M. Young & Co., Norwich	28.00	
				28.50	
10282	Bowker's Sure Crop Phosphate	Bowker Fertilizer Co., New York	Hubbell & Bradley, Saugatuck	30.00	14.04
			A. R. Manning & Co., Yantic	27.00	
				28.50	
10239	General Crop Fish Guano	Ohio Farmers' Fertilizer Co., Columbus, Ohio	W. Smith & Son, Canterbury	26.00	12.29
			R. B. Witter, Brooklyn	23.00	
			G. D. Bates, Putnam	25.00	
10051	Bradley's Niagara Phosphate	American Ag. Chem. Co., N. Y.	Phineas Platt, Milford	27.00	13.21
			W. L. Wellwood, South Coventry	30.00	
				28.50	
	2. *Sampled by Purchasers and others.*	*Manufacturer or Dealer.*	*Sent by*		
10110	Swift-Sure Superphosphate	M. L. Shoemaker & Co., Philadelphia	W. I. Stevens & Son, Hockanum	34.00	26.98
10055	Phosphate	Ernest L. James, Warrenville	Manufacturer	30.00	20.96
10190	Formula A	Sanderson Fertilizer & Chem. Co., New Haven	G. F. Douglass, Collinsville	35.00	23.78
10090	Peruvian Guano	Bowker Fertilizer Co., New York	Thos. L. Kenney, R. D. No. 2, Suffield	45.00	23.08
10040	Superphosphate	*	C. W. Beardsley, Milford		----

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* From the G. W. Miles estate, Milford.

ANALYSES AND VALUATIONS—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid.							Potash.		
		Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen Organic.	Total Nitrogen.		Soluble.	Reverted.	Insoluble.	Total.		Available.		Found.		Guaranteed.
					Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	
10281	82.6	---	0.03	1.40	1.43	**0.8**	4.80	2.93	1.39	9.12	**10.0**	7.73	**8.0**	1.69	2.95	**2.0**
10321	89.6	---	---	1.06	1.06	**0.8**	5.41	2.62	2.15	10.18	**9.0**	8.03	**8.0**	3.30	3.30	**4.0**
10162	93.0	---	---	1.04	1.04	**0.8**	3.90	4.21	3.67	11.78	**10.0**	8.11	**8.0**	3.99	3.99	**4.0**
10263	96.2	---	---	1.04	1.04	**0.8**	4.99	3.53	2.09	10.61	**10.0**	8.52	**8.0**	1.23	1.23	**1.0**
10119	98.2	---	---	1.30	1.30	**1.0**	5.01	3.39	2.17	10.57	**9.0**	8.40	**8.0**	2.20	2.20	**2.0**
10282	103.0	0.13	---	0.99	1.12	**0.8**	5.74	3.31	1.94	10.99	**10.0**	9.05	**9.0**	1.98	1.98	**2.0**
10239	103.4	0.03	---	0.94	0.97	**0.8**	2.90	5.51	1.79	10.20	**9.0**	8.41	**7.0**	1.48	1.48	**1.0**
10051	115.7	---	---	1.12	1.12	**0.8**	4.43	3.66	2.48	10.57	**8.0**	8.09	**7.0**	1.75	1.75	**1.0**
10110	26.0	0.93	---	2.21	3.14	**2.9**	9.01	3.89	2.04	14.94	**14.0**	12.90	**9.0**	0.59	4.73	**4.5**
10055	43.1	---	0.10	2.14	2.24	**2.5**	5.62	6.17	2.86	14.65	**13.4**	11.79	**10.1**	2.58	2.58	**2.3**
10190	47.2	0.93	0.10	2.61	3.64	**3.3**	4.75	2.64	0.95	8.34	**9.0**	7.39	**6.0**	5.88	5.88	**6.0**
10090	95.0	0.09	1.32	0.73	2.14	**2.6**	0.94	6.95	15.43	23.32	**26.0**	7.89	**7.3**	1.93	3.42	**1.4**
10040	----	---	0.52	1.31	1.83	----	0.13	3.75	18.38	22.26	....	3.88	....	....	0.71	----

SPECIAL MANURES.

Here are included such mixed fertilizers, chiefly nitrogenous superphosphates, as are claimed by their manufacturers to be specially adapted to the needs of particular crops.

1. *Samples Drawn by Station Agent.*

In the table on pages 68 to 85 are given analyses of one hundred and three brands represented bv samples drawn by the Station agents.

GUARANTEES.

Of the samples represented in the following tables, five failed to meet the maker's guarantee in respect of nitrogen, nine in respect of phosphoric acid and eleven in respect of potash; in all about one-fourth of the whole number of special manures examined.

The brands which thus failed to fully meet the minimum claims of the manufacturers by more than one-tenth per cent. were the following:—

10186. Boardman's Complete for Potatoes and General Crops. Potash found 9.70, guaranteed 10.0.

10192. National Fertz. Co.'s Chittenden's H. G. Special Tobacco Fertilizer. Total phosphoric acid found 6.35, guaranteed 7.0.

10527.* American Agricultural Chemical Co.'s H. G. Tobacco Manure. Available phosphoric acid found 3.20, guaranteed 5.0, potash found 9.69, guaranteed 10.0.

10309. Rogers' H. G. for Oats and Top Dressing. Available phosphoric acid found 6.86, guaranteed 7.0.

10122. Hubbard's Oats and Top Dressing. Nitrogen found 8.69, guaranteed 8.8.

10320. Shay's Potato Manure. Nitrogen found 2.59, guaranteed 3.0.

10121. Hubbard's Soluble Potato Manure. Nitrogen found 4.89, guaranteed 5.0.

9989.* American Agricultural Chemical Co.'s H. G. Tobacco Manure. Nitrogen found 5.41, guaranteed 5.8.

10172. Russia Cement Co.'s Essex Special Tobacco Manure. Nitrogen found 4.30, guaranteed 4.5.

10222. Bowker's Stockbridge Grass and Top Dressing. Potash found 5.33, guaranteed 6.0.

10220. Shoemaker's Swift-Sure Superphosphate for Potatoes. Potash found 6.20, guaranteed 7.0.

10200. Sanderson's Tobacco Fertilizer. Formula B. Total phosphoric acid 8.76, guaranteed 9.0.

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* See notice on page 65.

10210.* **Rogers' H. G. Complete Corn and Onion. Available phosphoric acid found 5.56, guaranteed 6.0.**

10187. Lister's Special 10% Potato. Potash found 9.58, guaranteed 10.0.

10053. Hubbard's Potato Phosphate. Potash found 4.77, guaranteed 5.0.

10288. American Farmers' Corn King. Potash found 3.78, guaranteed 4.0.

10207. American Farmers' Complete Potato. Potash found 5.55, guaranteed 6.0.

10031. Bowker's Stockbridge Corn Manure. Potash found 6.76, guaranteed 7.0.

10294.* **Rogers' Tobacco Starter. Available phosphoric acid found 3.88, guaranteed 6.0.**

10025. Sanderson's Potato Manure. Total phosphoric acid found 6.61, guaranteed 9.0.

10287. Coe's Celebrated Special Potato Fertilizer. Potash found 3.82, guaranteed 4.0.

10257. Lister's Corn and Potato Fertilizer. Potash found 2.82, guaranteed 3.0.

10026. Sanderson's Corn Superphosphate. Total phosphoric acid found 8.70, guaranteed 10.0.

9992. Bowker's Potato and Vegetable Phosphate. Available phosphoric acid found 8.08, guaranteed 9.0.

In some of these cases, at least, a deficiency of one ingredient is accompanied by a very considerable excess of another; these discrepancies being largely explained by imperfect mixing of the raw materials at the factory.

Analyses requiring Special Notice.

The American Agricultural Chemical Co.'s High Grade Tobacco Manure, **9989**, the analysis of which is given on pages 70 and 71, failed to meet the maker's guarantee in nitrogen by 0.35 per cent., while the percentage of potash found was 0.8 more than the minimum guarantee. At the request of the maker another sample was drawn and analyzed, which is numbered **10527** on pages 68 and 69. This shows 1½ per cent. more nitrogen than the minimum guarantee requires and about 0.3 per cent less potash.

The Russia Cement Co.'s Essex Special Tobacco Manure. In May last an analysis was made, No. **10044**, of a mixture of three samples drawn from the stock respectively of J. & H. Woodford, Avon; Spencer Brothers, Suffield; and the Blish

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* See notice on page 67.

Hardware Co., South Manchester. This analysis showed a deficiency of both nitrogen and potash and led to a request from the manufacturer that the Station would investigate further, as the analysis did not represent the average quality of the brand.

Accordingly, the three samples above referred to were separately analyzed and reported. It appeared that those from Spencer Brothers and J. & H. Woodford, Nos. **10171** and **10172**, pages 68 and 71, agreed fairly well in composition with the guaranteed composition, while the sample from the Blish Hardware Co., No. **10173**, was very different in composition. The agent then went to South Manchester and drew a new sample of this brand, **10757**, which was totally unlike the other in composition, but agreed well with the analyses of samples from Suffield and Avon. Both manufacturer and dealer state that only one shipment of this brand was made to the Blish Hardware Co. and that the entire shipment, with exception of one bag, was there at the time of the agent's second visit. It would seem, therefore, as if a mistake had been made on the part of the Station in sampling, or in labeling the first sample drawn from the Blish Hardware Co. All these analyses are here given, as it is the invariable rule of this Station to print every analysis of such fertilizers as are entered for sale in this state. We believe samples **10044** and **10173** do not at all represent the composition of this brand.

	10171	10172	10757	10044	10173
Nitrogen of nitrate	1.80	1.75	1.92	1.91	1.80
" as ammonia	0.05	0.04	0.00	0.00	0.00
" organic	3.11	2.51	2.94	2.39	1.95
" total	4.96	4.30	4.86	4.30	3.75
Phosphoric acid, soluble	3.17	3.21	3.84	4.08	4.02
" " reverted	3.07	2.93	2.58	2.67	3.06
" " insoluble	3.07	3.62	3.52	3.74	4.05
" " total	9.31	9.76	9.94	10.49	11.13
Potash	12.33	12.95	12.25	11.15	8.17

It is claimed by the manufacturer that one half of the potash in Mapes' Tobacco Manure, Wrapper Brand, sample No. **10088**, pages 70 and 71, is in form of carbonate. If one-half of the potash were valued as carbonate at 8, the valuation would be $38.31 instead of $34.83 as in the table. For remarks on the use of carbonate of potash in tobacco fertilizers see page 31.

The Rogers Manufacturing Co. call attention to the percentage of available phosphoric acid in the sample of their High Grade Complete Corn and Onion Manure, No. **10210**, pages 72 and 73, which is lower than the guarantee. A sample sent by the manufacturer, No. **10542**, the analysis of which will be found on pages 84 and 85, contained 6.90 per cent. available phosphoric acid, which is well above the guarantee.

A similar objection was made to the analysis of Rogers Tobacco Starter, No. **10294**, pages 80 and 81, in which the available phosphoric acid was 3.88 per cent. where 6.00 was guaranteed.

A second sample of the same brand sent by the manufacturer, No. **10546**, pages 84 and 85, contained 4.80 per cent. of available phosphoric acid.

COST AND VALUATION.

The method of ascertaining the retail cash cost price of the special manures and of computing the valuation is the same as described on page 15.

The average cost per ton of the one hundred and three special manures included in the tables was $33.30, the valuation, $23.53, and the percentage difference, 41.5.

In 1902 the corresponding figures were: Average cost, $33.35; valuation, $24.05; percentage difference, 38.7.

The average composition and cost of special manures for the last three years has been as follows:

PERCENTAGE COMPOSITION.

Year.	Nitrogen.	Available. phosphoric acid.	Potash.	Cost per ton.
1903	3.03	8.00	6.32	$33.30
1902	3.03	8.17	6.08	33.35
1901	2.87	8.88	6.44	32.64
1900	2.86	8.90	6.35	32.73

2. *Special Manures Sampled by Manufacturers or Purchasers.*

In the table on pages 84 and 85 are included five analyses of samples sent to the Station for analysis by manufacturers or purchasers.

SPECIAL MANURES, SAMPLED BY THE STATION.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	1. *Sampled by Station Agent.*				
10191	Complete Tobacco Manure	American Agricultural Chemical Co., N. Y.	S. J. Stevens, Glastonbury	$33.00	$29.87
10186	Boardman's Complete Fertilizer for Potatoes and General Crops	F. E. Boardman, Westfield	Manufacturer	31.00	27.84
10192	Chittenden's H. G. Special Tobacco Fertilizer	National Fertilizer Co., Bridgeport	J. N. Lasbury, Broad Brook	41.00	36.74
10527	H. G. Tobacco Manure*	American Agricultural Chemical Co., N. Y.	L. J. Grant, Wapping	44.00	38.24
10180	H. G. Grass and Grain Fertilizer	Rogers Mfg. Co., Rockfall	Manufacturer	40.00	32.85
			R. H. Hall, East Hampton	38.00	
				39.00	
10309	H. G. Fertilizer for Oats and Top Dressing	Rogers Mfg. Co., Rockfall	Robt. E. Davis, Guilford	40.00	35.14
			Arthur Sikes, Suffield	42.00	
			Rockville Milling Co., Rockville	44.00	
10203	Gladiator Truck and Potato	Nassau Fertilizer Co., N. Y.	C. Buckingham, Southport	30.00	25.04
10216	Essex Special Tobacco Manure	Russia Cement Co., Gloucester, Mass.	W. J. Cox, East Hartford	43.00	35.71
10195	Hubbard's Soluble Tobacco Manure	The Rogers & Hubbard Co., Middletown	H. W. Andrews, Wallingford	44.00	36.43
			R. H. Hall, East Hampton	44.00	
			H. H. McKnight, Ellington	41.75	
10122	Hubbard's Oats and Top Dressing	The Rogers & Hubbard Co., Middletown	F. T. Blish Hdw. Co., South Manchester	49.00	40.45
			S. E. Frisbie, Milford	50.00	
			H. W. Andrews, Wallingford	48.00	
10320	Shay's Potato Manure	C. M. Shay, Groton	Manufacturer	30.00	24.33
10171	Essex Special Tobacco Manure*	Russia Cement Co., Gloucester, Mass.	Spencer Bros., Suffield	44.00	34.80
				43.00	
10757	Essex Special Tobacco Manure*	Russia Cement Co., Gloucester, Mass.	F. T. Blish Hdw. Co., South Manchester	43.00	34.71
10194	H. G. Soluble Tobacco Manure	Rogers Mfg. Co., Rockfall	W. E. Bostwick, New Milford	44.00	35.44
			Arthur Sikes, Suffield	42.00	
10107	Essex Complete Manure for Potatoes, Roots & Vegetables	Russia Cement Co., Gloucester, Mass.	W. J. Cox, East Hartford	38.00	30.88
			Spencer Bros., Suffield	39.00	
				38.50	

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* See note, page 65.

ANALYSES AND VALUATIONS.

Station No.	Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid.							Potash.		
					Total Nitrogen.					Total.		Available.		Found.		
		Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen Organic.	Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	Guaranteed.
10191	10.5	0.07	---	4.97	5.04	4.5	0.27	4.27	5.82	10.36	4.0	4.54	3.0	1.58	7.01	5.5
10186	11.4	0.05	---	3.59	3.64	3.2	6.37	1.69	0.38	8.44	....	8.06	8.0	9.70	9.70	10.0
10192	11.6	....	1.30	4.74	6.04	5.7	5.18	0.81	0.36	6.35	7.0	5.99	5.0	0.85	10.75	10.0
10527	15.1	0.06	1.42	5.81	7.29	5.8	0.18	3.02	3.26	6.46	6.0	3.20	5.0	1.54	9.69	10.0
10180	18.7	0.04	0.06	3.12	3.22	3.0	none	7.49	10.38	17.87	16.0	7.49	----	13.85	13.85	12.5
10309	19.5	4.52	0.13	2.19	6.84	6.3	1.31	5.55	3.99	10.85	9.0	6.86	7.0	7.59	7.59	7.5
10203	19.8	0.58	0.15	2.57	3.30	3.3	5.63	2.25	1.46	9.34	8.0	7.88	7.0	7.74	7.74	7.0
10216	20.4	1.56	---	3.47	5.03	4.5	5.18	2.61	1.09	8.88	7.5	7.79	5.5	1.38	12.25	12.0
10195	20.8	2.66	0.18	2.21	5.05	5.0	0.69	8.83	3.21	12.73	10.0	9.52	7.0	0.93	11.49	10.0
10122	21.1	7.38	---	1.31	8.69	8.8	0.08	4.79	3.22	8.09	7.9	4.87	3.9	10.20	10.20	8.4
10320	23.3	0.61	---	1.98	2.59	3.0	4.64	4.48	4.75	13.87	9.0	9.12	8.0	5.80	6.98	5.0
10171	23.6	1.80	0.05	3.11	4.96	4.5	3.17	3.07	3.07	9.31	7.5	6.24	5.5	1.49	12.33	12.0
10757	23.9	1.92	---	2.94	4.86	4.5	3.84	2.58	3.52	9.94	7.5	6.42	5.5	1.53	12.25	12.0
10194	24.2	1.71	0.16	3.45	5.32	5.0	1.89	5.58	2.10	9.57	8.0	7.47	6.0	0.84	11.15	11.0
10107	24.7	0.64	---	3.37	4.01	3.7	5.44	3.02	4.19	12.65	9.0	8.46	7.0	1.32	8.70	8.5

SPECIAL MANURES, SAMPLED BY THE STATION.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	Sampled by Station Agent.				
10182	Darling's Tobacco Grower	American Agricultural Chemical Co., N. Y.	J. S. Warner, Glastonbury	$39.00	$30.46
			E. P. Latham, Granby	38.00	
			E. F. Miller, Ellington	36.00	
10181	Hubbard's Grass and Grain Fertilizer	The Rogers & Hubbard Co., Middletown	F. T. Blish Hdw. Co., South Manchester	39.00	30.77
			H. W. Andrews, Wallingford	38.00	
				38.50	
10198	Wilcox' Potato, Onion and Tobacco Manure	Wilcox Fertilizer Works, Mystic	I. W. Dennison, Mystic	35.00	27.68
			Olds & Whipple, Hartford	37.00	
10121	Hubbard's Soluble Potato Manure	The Rogers & Hubbard Co., Middletown	H. W. Andrews. Wallingford	38.00	30.70
			S. E. Frisbie, Milford	40.00	
				39.00	
9989	High Grade Tobacco Manure*	American Agricultural Chemical Co., N. Y.	Spencer Bros., Suffield	44.00	34.57
			E. N. Austin, Suffield	42.00	
10196	H. G. Soluble Tobacco and Potato Manure	Rogers Mfg. Co., Rockfall	Arthur Sikes, Suffield	38.00	29.84
10172	Essex Special Tobacco Manure*	Russia Cement Co., Gloucester, Mass.	J. & H. Woodford, Avon	42.00	33.40
				43.00	
10218	Mapes' Seeding Down Manure	Mapes F. & P. G. Co., N. Y.	Mapes' Branch, Hartford	39.00	30.29
9998	East India Potato Manure	American Agricultural Chemical Co., N. Y.	S. J. Stevens, Glastonbury	36.00	27.49
			Edward White, Rockville	35.00	
				35.50	
10100	Mapes' Economical Potato Manure	Mapes F. & P. G. Co., N. Y.	James H. Barker, Branford	33.00	25.56
			E. F. Strong, Colchester	34.00	
				33.50	
10088	Mapes' Tobacco Manure (Wrapper Brand)*	Mapes F. & P. G. Co., N. Y.	Spencer Bros., Suffield	46.00	34.83
			F. S. Bidwell & Co., Windsor Locks	46.00	
10189	Chittenden's Complete Tobacco Fertilizer	National Fertilizer Co., Bridgeport	J. N. Lasbury, Broad Brook	35.00	26.43
			John Kane,† Suffield	35.00	
			Geo. N. Thompson,† Suffield	34.50	
9991	Stockbridge Potato & Vegetable Manure	Bowker Fertilizer Co., N. Y.	Theo. Houser,† Suffield	37.00	27.16
			E. B. Clark Co., Milford	33.00	
			Lightbourn & Pond Co., New Haven	37.00	
				36.00	

* See note, pages 65 and 66.

† Purchaser, not a dealer.

ANALYSES AND VALUATIONS—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid.							Potash.		
		Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen Organic.	Total Nitrogen.		Soluble.	Reverted.	Insoluble.	Total.		Available.		Found.		Guaranteed.
					Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	
10182	24.8	1.55	0.46	2.66	4.67	4.5	3.42	2.52	0.55	6.49	6.0	5.94	4.0	4.58	10.53	10.0
10181	25.1	0.05	0.04	2.75	2.84	2.5	none	8.96	8.23	17.19	15.0	8.96	6.6	12.55	12.55	12.5
10198	26.4	1.02	0.16	2.61	3.79	3.3	5.97	2.65	1.74	10.36	8.0	8.62	7.0	1.24	7.19	6.0
10121	27.0	2.55	0.26	2.08	4.89	5.0	0.64	8.95	3.71	13.30	10.0	9.59	7.0	1.01	6.00	5.0
9989	27.2	....	1.97	3.44	5.41	5.8	3.63	1.35	2.68	7.66	6.0	4.98	5.0	1.73	10.81	10.0
10196	27.3	0.70	0.09	3.07	3.86	3.5	1.95	6.22	3.19	11.36	9.0	8.17	7.0	1.01	9.11	8.8
10172	28.7	1.75	0.04	2.51	4.30	4.5	3.21	2.93	3.62	9.76	7.5	6.14	5.5	1.02	12.95	12.0
10218	28.8	1.31	0.08	1.51	2.90	....	0.35	8.52	9.69	18.56	18.0	8.87	....	8.72	11.24	10.0
9998	29.1	0.49	0.80	2.18	3.47	3.3	5.02	2.11	0.94	8.07	7.0	7.13	6.0	10.85	10.85	10.0
10100	31.1	2.32	0.08	1.25	3.65	3.3	2.29	2.96	1.81	7.06	6.0	5.25	4.0	1.34	9.12	8.0
10088	32.1	4.67	0.08	1.74	6.49	6.2	0.05	2.36	3.13	5.54	4.5	2.41	....	1.18	11.61	10.5
10189	32.4	....	0.52	3.11	3.63	3.3	7.38	2.10	1.14	10.62	10.0	9.48	8.0	0.72	5.37	5.4
9991	32.5	1.25	0.31	2.10	3.66	3.0	3.42	2.97	2.32	8.71	7.0	6.39	6.0	10.34	10.34	10.0

SPECIAL MANURES, SAMPLED BY THE STATION.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	Sampled by Station Agent.				
10202	O. & W. Potato Manure	Olds & Whipple, Hartford	Manufacturer	$32.00	$24.16
10291	Wilcox' Potato Manure	Wilcox Fertilizer Works, Mystic	Spencer Bros., Suffield	28.00	20.29
			W. A. Howard, Woodstock	28.00	
			Waldo Tillinghast, Plainfield	25.00	
				27.00	
10302	Bowker's Fairfield Onion Fertilizer	Bowker Fertilizer Co., N. Y.	Bowker's Branch, Southport	35.00	25.98
10185	Armour's H. G. Potato Fertilizer	Armour Fertilizer Works, Baltimore, Md.	F. E. Tucker, Vernon	34.00	23.69
			E. A. Buck & Co., Willimantic	32.00	
			F. C. Benjamin & Co. Danbury	30.00	
			Meriden Grain and Feed Co., Meriden	34.00	
10222	Stockbridge Grass and Top Dressing	Bowker Fertilizer Co., N. Y.	Bowker's Branch, Hartford	37.00	27.29
10108	Essex Complete Manure for Corn, Grain and Grass	Russia Cement Co., Gloucester, Mass.	W. J. Cox, East Hartford	38.00	27.93
			G. M. Cox, Vernon	38.00	
10220	Swift-Sure Superphosphate for Potatoes	M. L. Shoemaker & Co., Phila., Pa.	J. G. Schwink, Meriden	34.00	24.97
			Loomis Bros., Granby	34.00	
10312	Packers' Union Potato Manure	American Agricultural Chemical Co., N. Y.	T. A. Tillinghast, Brooklyn	30.00	23.02
			R. M. Fenn, Middlebury	33.00	
				31.50	
10297	Tobacco Starter and Grower	American Agricultural Chemical Co., N. Y.	Broad Brook Lumber Co., Broad Brook	33.00	24.05
			Edward White, Rockville	33.00	
10213	Swift's Lowell Potato Phosphate	Swift's Lowell Fertilizer Co., Boston, Mass.	S. W. Bray, Milford	32.00	23.13
			Spencer Bros., Suffield	35.00	
			Geo. S. Jennings, Southport	30.00	
10200	Sanderson's Tobacco Fertilizer. Formula B	Sanderson Fertilizer and Chemical Co., New Haven	Herman Birke,† Hillstown	33.00	23.75
			J. O. Griswold,† Glastonbury	33.00	
10210	H. G. Complete Corn and Onion Manure*	Rogers Mfg. Co., Rockfall	Robt. E. Davis, Guilford	33.00	24.46
			Arthur Sikes, Suffield	34.00	
			Rockville Milling Co., Rockville	36.00	
10290	Wilcox' Grass Fertilizer	Wilcox Fertilizer Works, Mystic	Manufacturer	35.00	25.00

* See note, page 67.

† Purchaser, not a dealer.

ANALYSES AND VALUATIONS—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid.							Potash.		
		Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen Organic.	Total Nitrogen.		Soluble.	Reverted.	Insoluble.	Total.		Available.		Found.		Guaranteed.
					Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	
10202	32.5	0.66	---	2.59	3.25	----	3.05	3.22	1.24	7.51	----	6.27	5.0	0.84	7.67	7.0
10291	33.1	0.35	0.16	1.96	2.47	2.0	2.24	4.35	4.48	11.07	7.0	6.59	----	5.56	5.56	4.5
10302	34.7	0.64	0.40	2.55	3.59	3.3	4.38	4.77	2.88	12.03	9.0	9.15	8.0	5.98	5.98	6.0
10185	35.1	0.29	---	1.51	1.80	1.7	7.15	1.91	0.65	9.71	----	9.06	8.0	7.11	10.53	10.0
10222	35.6	2.00	0.96	1.99	4.95	4.9	6.14	1.10	0.56	7.80	6.0	7.24	4.0	5.33	5.33	6.0
10108	36.1	0.76	---	2.77	3.53	3.3	4.69	3.35	2.69	10.73	9.5	8.04	----	9.71	9.71	9.5
10220	36.2	0.88	---	1.85	2.73	2.8	7.52	3.56	2.88	13.96	----	11.08	----	6.20	6.20	7.0
10312	36.8	0.67	---	1.84	2.51	2.1	6.24	2.77	1.74	10.75	9.0	9.01	8.0	7.30	7.30	6.0
10297	37.2	1.30	---	2.21	3.51	3.3	7.09	2.19	1.22	10.50	10.0	9.28	8.0	4.73	4.73	4.0
10213	38.3	0.19	---	2.50	2.69	2.5	6.05	2.61	1.25	9.91	9.0	8.66	8.0	0.76	6.13	6.0
10200	38.9	1.12	---	2.28	3.40	3.3	4.22	3.09	1.45	8.76	9.0	7.31	6.0	0.96	5.93	6.0
10210	39.0	0.93	0.10	2.61	3.64	3.0	2.27	3.29	3.63	9.19	8.0	5.56	6.0	7.45	7.45	7.0
10290	40.0	1.88	---	2.19	4.07	4.1	3.14	3.99	2.35	9.48	7.0	7.13	----	5.82	5.82	5.0

Special Manures, Sampled by the Station.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	Sampled by Station Agent.				
10195	Mapes' Potato Manure	Mapes F. & P. G. Co., N. Y.	F. S. Bidwell & Co., Windsor Locks	$38.00	$26.74
			E. F. Strong, Colchester	37.00	
				37.50	
10187	Lister's Special 10% Potato	Lister's Agricultural Chemical Works, Newark, N. J.	A. I. Martin, Wallingford	33.00	23.41
10164	Great Eastern Vegetable, Vine & Tobacco	American Agricultural Chemical Co., N. Y.	T. E. Greene, Plainfield	30.00	21.96
			S. A. Post, Westbrook	32.00	
				31.00	
10184	Wheeler's Havana Tobacco Grower	American Agricultural Chemical Co., N. Y.	Bruce B. Beach, New Milford	35.00	24.76
10027	Bowker's Early Potato Manure	Bowker Fertilizer Co., N. Y.	Bowker's Branch, Southport	35.00	25.35
			C. W. & T. F. Atwood, Watertown	37.00	
				36.00	
10240	Swift's Perfect Tobacco Grower	Swift's Lowell Fertilizer Co., Boston, Mass.	Ed. Galvin, New Milford	38.00	26.56
			C. W. Keeler, Danbury	38.00	
			F. S. Bidwell & Co., Windsor Locks	39.00	
10293	Shay's Corn Manure	C. M. Shay, Groton	Manufacturer	26.00	18.07
10054	Hubbard's '02 Top Dress Phosphate	The Rogers & Hubbard Co., Middletown	H. W. Andrews, Wallingford	34.00	23.83
			S. E. Frisbie, Milford	35.00	
				34.50	
10099	Essex Tobacco Starter	Russia Cement Co., Gloucester, Mass.	J. & H. Woodford, Avon	32.00	22.68
			W. J. Cox, East Hartford	33.00	
			F. J. Cooley, Rockville	34.00	
10032	Bowker's Potato and Vegetable Fertilizer	Bowker Fertilizer Co., N. Y.	Bowker's Branch, Southport	30.00	20.61
			O. H. Meeker, Danbury	30.00	
10053	Hubbard's Potato Phosphate	The Rogers & Hubbard Co., Middletown	H. W. Andrews, Wallingford	30.00	21.27
			S. E. Frisbie, Milford	32.00	
				31.00	
10310	Bradley's Complete Manure for Potatoes and Vegetables	American Agricultural Chemical Co., N. Y.	W. B. Martin, Rockville	36.00	25.14
			C. M. Beach, New Milford	38.00	
				37.00	

ANALYSES AND VALUATIONS—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid.							Potash.		
		Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen Organic.	Total Nitrogen.		Soluble.	Reverted.	Insoluble.	Total.		Available.		Found.		Guaranteed.
					Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	
10105	40.2	2.07	0.18	1.59	3.84	3.7	3.84	4.15	1.72	9.71	8.0	7.99	8.0	1.41	7.23	6.0
10187	41.0	....	0.15	1.62	1.77	1.6	7.38	1.16	1.08	9.62	9.0	8.54	8.0	1.41	9.58	10.0
10164	41.2	0.51	0.06	1.69	2.26	2.1	6.21	2.92	2.18	11.31	10.0	9.13	8.0	6.67	6.67	6.0
10184	41.4	....	0.20	2.55	2.75	2.5	5.09	2.29	0.60	7.98	7.0	7.38	6.0	10.28	10.28	10.0
10027	42.0	0.77	0.78	1.85	3.40	3.3	5.17	2.41	2.31	9.89	8.0	7.58	7.0	7.67	7.67	7.0
10240	43.1	1.33	0.12	2.82	4.27	4.1	2.58	4.41	1.17	8.16	8.0	6.99	7.0	0.74	6.35	6.0
10293	43.9	....	...	1.79	1.79	1.6	3.82	4.25	6.64	14.71	9.0	8.07	8.0	2.92	2.92	2.5
10054	44.8	3.82	0.00	0.78	4.60	4.5	3.42	2.49	0.42	6.33	6.0	5.91	4.5	5.27	5.27	4.5
10099	45.5	1.53	...	1.13	2.66	2.5	6.27	4.66	3.59	14.52	12.0	10.93	9.0	0.56	3.52	2.5
10032	45.6	0.69	0.14	1.63	2.46	2.5	7.09	2.42	1.95	11.46	9.0	9.51	8.0	4.01	4.01	4.0
10053	45.7	1.03	...	1.13	2.16	2.0	7.26	3.98	1.43	12.67	10.0	11.24	9.0	4.77	4.77	5.0
10310	47.2	1.05	0.16	2.19	3.40	3.3	4.99	3.05	2.54	10.58	9.0	8.04	8.0	7.09	7.09	7.0

SPECIAL MANURES, SAMPLED BY THE STATION.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	Sampled by Station Agent.				
10288	American Farmers' Corn King	American Farmers' Fertilizer Co., N. Y.	H. T. Childs,* Woodstock	....	$20.64
			S. V. Osborn, Branford	$32.00	
			F. H. Rolf, Guilford	29.00	
				30.50	
10242	Potato and Tobacco Special	Ohio Farmers' Fertilizer Co., Columbus, Ohio	J. H. Lynch, Ellington	26.00	17.49
10109	Hubbard's Soluble Corn and General Crops	The Rogers & Hubbard Co., Middletown	H. W. Andrews, Wallingford	35.00	23.49
			S. E. Frisbie, Milford	35.00	
10163	Read's Vegetable and Vine Fertilizer	American Agricultural Chemical Co., N. Y.	O. Russ, Mt. Hope	31.00	21.04
			L. A. Fenton, Norwich Town	32.00	
				31.50	
10298	Williams & Clark's Americus Potato Manure	American Agricultural Chemical Co., N. Y.	W. H. Chappell, Chesterfield	28.00	18.69
			Carlos Bradley, Ellington	28.00	
10207	American Farmers' Complete Potato Fertilizer	American Farmers' Fertilizer Co., N. Y.	F. H. Rolf, Guilford	28.00	19.33
			S. V. Osborn, Branford	30.00	
				29.00	
10104	Mapes' Corn Manure	Mapes F. & P. G. Co., N. Y.	James H. Barker, Branford	32.00	21.94
			F. S. Bidwell & Co., Windsor Locks	34.00	
				33.00	
9995	Bradley's Potato Manure	American Agricultural Chemical Co., N. Y.	Scofield & Miller, Stamford	32.00	21.10
			Spencer Bros., Suffield	32.00	
			F. S. Bidwell & Co., Windsor Locks	32.00	
10047	Quinnipiac Potato Manure	American Agricultural Chemical Co., N. Y.	Meeker Coal Co., Norwalk	32.00	20.96
			Adams & Canfield, R. D., Norwalk	32.00	
			C. Buckingham, Southport	27.00	
10316	Complete Potato and Vegetable Fertilizer	Rogers Mfg. Co., Rockfall	E. F. Strong, Colchester	33.00	20.90
			Robt. E. Davis, Guilford	30.00	
			Rockville Milling Co., Rockville	33.00	
				32.00	

* Purchaser, not a dealer.

ANALYSES AND VALUATIONS—*Continued.*

Station No.	Percentage difference between cost and valuation.	NITROGEN.					PHOSPHORIC ACID.							POTASH.		
		Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen Organic.	Total Nitrogen. Found.	Total Nitrogen. Guaranteed.	Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Found. As Muriate.	Found. Total.	Guaranteed.
10288	47.8	....	0.51	2.03	2.54	**2.4**	7.74	1.44	1.04	10.22	**9.5**	9.18	**8.0**	2.49	3.78	**4.0**
10242	48.7	....	...	1.62	1.62	**1.6**	5.55	3.49	2.14	11.18	**10.0**	9.04	**8.0**	3.92	3.92	**4.0**
10109	49.0	1.05	0.18	1.35	2.58	**2.5**	2.56	5.36	1.97	9.89	**8.0**	7.92	**6.0**	9.10	9.10	**8.0**
10163	49.7	0.34	...	1.90	2.24	**2.1**	6.22	2.19	1.40	9.81	**9.0**	8.41	**8.0**	6.65	6.65	**6.0**
10298	49.8	0.40	...	1.88	2.28	**2.1**	5.60	3.29	1.88	10.77	**10.0**	8.89	**8.0**	3.15	3.15	**3.0**
10207	50.0	....	...	1.80	1.80	**1.6**	7.04	1.67	1.23	9.94	**8.5**	8.71	**7.0**	3.38	5.55	**6.0**
10104	50.4	0.88	0.10	1.53	2.51	**2.5**	3.22	4.95	2.61	10.78	**10.0**	8.17	**8.0**	6.88	6.88	**6.0**
9995	51.7	....	0.46	2.19	2.65	**2.5**	4.64	2.42	2.37	9.43	**7.0**	7.06	**6.0**	5.85	5.85	**5.0**
10047	52.7	....	0.32	2.27	2.59	**2.5**	4.58	2.65	2.33	9.56	**7.0**	7.23	**6.0**	5.82	5.82	**5.0**
10316	53.1	0.67	...	1.85	2.52	**2.3**	5.44	2.78	2.14	10.36	**10.0**	8.22	**8.0**	5.43	5.43	**5.0**

SPECIAL MANURES, SAMPLED BY THE STATION.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	Sampled by Station Agent.				
10160	Wheeler's Potato Manure	American Agricultural Chemical Co., N. Y.	W. H. Baldwin, Cheshire	$29.00	$19.25
			Stanton A. Winsor,* Danielson	....	
			Henry S. Judd, Middlebury	30.00	
				29.50	
10157	Williams & Clark's Potato Phosphate	American Agricultural Chemical Co., N. Y.	D. B. Wilson Co., Waterbury	32.00	20.80
			Phineas Platt, Milford	33.00	
			Geo. Beaumont, Wallingford	32.00	
10225	Chittenden's Potato Phosphate	National Fertilizer Co., Bridgeport	A. H. Cashen, Meriden	33.00	21.02
			G. A. & H. B. Williams, E. Hartford	32.00	
				32.50	
10318	Hubbard's Corn Phosphate	The Rogers & Hubbard Co., Middletown	H. W. Andrews, Wallingford	25.00	17.07
			S. E. Frisbie, Milford	28.00	
				26.50	
10232	E. Frank Coe's Columbian Potato Fertilizer	E. Frank Coe Co., N. Y.	A. L. Burdick, Westbrook	30.00	19.30
10279	Armour's Grain Grower	Armour Fertilizer Works, Baltimore, Md.	J. M. Young & Co., Norwich	25.00	15.76
			E. A. Buck & Co., Willimantic	24.00	
				24.50	
10271	Bradley's Complete Top Dressing for Grass and Grain	American Agricultural Chemical Co., N. Y.	W. B. Martin, Rockville	36.00	23.12
10028	Bowker's Tobacco Starter	Bowker Fertilizer Co., N. Y.	Bowker's Branch, Hartford	34.00	21.36
			Seth Viets, Suffield	33.00	
				33.50	
10273	Great Eastern Northern Corn Special	American Agricultural Chemical Co., N. Y.	Elmer Keeler, Danbury	32.00	20.34
			M. H. Tyler, Plainville	32.00	
10031	Stockbridge Corn Manure	Bowker Fertilizer Co., N. Y.	W. B. Martin, Rockville	38.00	24.75
			Norwalk Coal Co., Norwalk	40.00	
				39.00	
10046	Essex Market Garden and Potato Manure	Russia Cement Co., Gloucester, Mass.	E. F. Strong, Colchester	34.00	21.18
			W. J. Cox, East Hartford	33.00	
				33.50	

* Sample was taken at Danielson R.R. station from bags marked with this name.

ANALYSES AND VALUATIONS—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid.							Potash.		
		Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen Organic.	Total Nitrogen.		Soluble.	Reverted.	Insoluble.	Total.		Available.		Found.		Guaranteed.
					Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	
10160	53.2	0.26	----	2.04	2.30	**2.1**	6.46	2.75	1.33	10.54	**9.0**	9.21	**8.0**	3.52	3.52	**3.0**
10157	53.8	----	----	2.64	2.64	**2.5**	4.38	2.87	2.38	9.63	**7.0**	7.25	**6.0**	5.45	5.45	**5.0**
10225	54.6	0.35	----	1.73	2.08	**2.1**	6.82	2.29	1.42	10.53	**10.0**	9.11	**8.0**	6.53	6.53	**6.0**
10318	55.2	0.17	----	1.08	1.25	**1.0**	6.58	3.82	1.23	11.63	**10.0**	10.40	**8.0**	4.02	4.02	**3.5**
10232	55.4	----	0.30	1.44	1.74	**1.2**	7.60	2.19	1.37	11.16	**9.5**	9.79	**8.5**	2.17	4.54	**2.5**
10279	55.5	0.41	----	1.36	1.77	**1.6**	6.37	2.35	1.08	9.80	----	8.72	**8.0**	2.20	2.20	**2.0**
10271	55.7	4.60	----	0.24	4.84	**4.3**	2.35	3.28	0.82	6.45	**6.0**	5.63	**5.0**	0.73	3.54	**2.5**
10028	56.8	0.83	0.06	1.97	2.86	**2.5**	6.99	2.13	1.82	10.94	**10.0**	9.12	**8.0**	0.44	3.31	**3.0**
10273	57.3	----	----	2 58	2.58	**2.5**	7.82	2.28	1.18	11.28	**11.0**	10.10	**9.0**	2.63	2.63	**2.0**
10031	57.6	0.51	0.52	2.43	3.46	**3.3**	5.92	2.00	1.15	9.07	**8.0**	7.92	**7.0**	6.76	6.76	**7.0**
10046	58.2	0.52	----	1.72	2.24	**2.0**	5.09	4.05	2.89	12.03	**10.0**	9.14	**8.0**	5.64	5.64	**5.0**

SPECIAL MANURES, SAMPLED BY THE STATION.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	Sampled by Station Agent.				
10307	Swift's Lowell Potato Manure	Swift's Lowell Fertilizer Co., Boston, Mass.	Spencer Bros., Suffield	$30.00	$18.90
			H. A. Bugbee, Willimantic	27.00	
10167	Quinnipiac Potato Phosphate	American Agricultural Chemical Co., N. Y.	G. M. Williams Co., New London	32.00	18.90
			Young Bros. Co., Danielson	**30.00**	
			J. P. Lathrop, Plainfield	28.00	
10299	Wheeler's Bermuda Onion Grower	American Agricultural Chemical Co., N. Y.	W. H. Baldwin, Cheshire	**26.00**	16.37
10294	Tobacco Starter*	Rogers Mfg. Co., Rockfall	R. A. Sikes, Ellington	**34.00**	21.41
10165	Packer's Union Animal Corn Fertilizer	American Agricultural Chemical Co., N. Y.	T. A. Tillinghast, Brooklyn	30.00	19.50
			R. M. Fenn, Middlebury	32.00	
				31.00	
10117	Darling's Potato Manure	American Agricultural Chemical Co., N. Y.	M. D. Stanley, New Britain	33.00	19.86
			J. S. Warner, Glastonbury	34.00	
			T. E. Greene, Plainfield	30.00	
				32.00	
10270	Quinnipiac Corn Manure	American Agricultural Chemical Co., N. Y.	G. M. Williams Co., New London	30.00	17.92
			J. P. Lathrop, Plainfield	28.00	
				29.00	
10233	American Farmers' Grain Grower	American Farmers' Fertilizer Co., N. Y.	H. A. Bugbee, Willimantic	25.00	15.09
			E. F. Strong, Colchester	24.00	
				24.50	
10188	Mapes' Fruit and Vine Manure	Mapes F. & P. G. Co., N. Y.	Mapes' Branch, Hartford	**38.00**	23.37
10048	Crocker's Ammoniated Corn Phosphate	American Agricultural Chemical Co., N. Y.	W. L. Wellwood, South Coventry	30.00	17.98
			F. M. Loomis, North Granby	29.00	
				29.50	
10049	Crocker's Potato, Hop and Tobacco Phosphate	American Agricultural Chemical Co., N. Y.	W. L. Wellwood, South Coventry	32.00	19.18
			F. M. Loomis, North Granby	31.00	
				31.50	

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* See note, page 67.

ANALYSES AND VALUATIONS—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen. Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen Organic.	Total Nitrogen. Found.	Total Nitrogen. Guaranteed.	Phosphoric Acid. Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Potash. Found. As Muriate.	Found. Total.	Guaranteed.
10307	58.7	0.10	...	1.94	2.04	**1.6**	5.12	2.38	1.65	9.15	**8.0**	7.50	**7.0**	0.27	4.87	**4.0**
10167	58.7	0.53	...	1.66	2.19	**2.1**	5.46	3.80	2.61	11.87	**10.0**	9.26	**8.0**	3.15	3.15	**3.0**
10299	58.8	....	...	1.13	1.13	**0.8**	6.42	2.34	0.96	9.72	**9.0**	8.76	**8.0**	1.10	4.66	**4.0**
10294	58.8	0.90	0.10	1.98	2.98	**2.5**	0.98	2.90	7.49	11.37	**8.0**	3.88	**6.0**	1.80	5.70	**5.0**
10165	59.0	0.36	...	2.04	2.40	**2.5**	7.04	3.00	1.58	11.62	**11.0**	10.04	**9.0**	2.48	2.48	**2.0**
10117	61.1	0.69	0.10	1.83	2.62	**2.5**	4.58	3.02	0.61	8.21	**7.0**	7.60	**6.0**	5.22	5.22	**5.0**
10270	**61.8**	0.20	0.11	2.01	2.32	**2.1**	5.01	4.09	2.50	11.60	**10.0**	9.10	**8.0**	1.55	1.55	**1.5**
10233	**62.4**	....	0.18	0.82	1.00	**0.8**	6.78	4.24	2.67	13.69	**9.5**	11.02	**8.0**	1.31	1.31	**1.0**
10188	**62.6**	1.20	0.16	1.00	2.36	**1.6**	2.37	3.11	1.85	7.33	**7.0**	5.48	**5.0**	1.70	10.70	**10.0**
10048	**64.1**	0.13	...	2.17	2.30	**2.1**	6.43	2.59	1.82	10.84	**9.0**	9.02	**8.0**	1.90	1.90	**1.5**
10049	**64.2**	0.34	...	1.88	2.22	**2.1**	6.37	2.41	1.56	10.34	**9.0**	8.78	**8.0**	4.11	4.11	**3.0**

Special Manures, Sampled by the Station.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	Sampled by Station Agent.				
10158	Williams & Clark's Americus Corn Phosphate	American Agricultural Chemical Co., N. Y.	W. H. Chappell, Chesterfield	$28.00	$17.44
			Geo. Beaumont, Wallingford	30.00	
				29.00	
9988	Grass and Lawn Top Dressing	American Agricultural Chemical Co., N. Y.	S. A. Billings, Meriden	36.00	21.00
			W. L. Wellwood, South Coventry	34.00	
				35.00	
10238	Essex Corn Fertilizer	Russia Cement Co., Gloucester, Mass.	W. J. Cox, East Hartford	**33.00**	19.72
10025	Sanderson's Potato Manure	Sanderson Fertilizer & Chemical Co., New Haven	E. B. Clark Co., Milford	28.00	17.10
			Geo. W. Eaton, Plainville	30.00	
			Manufacturer	30.00	
				29.00	
9994	Bradley's Corn Phosphate	American Agricultural Chemical Co., N. Y.	F. S. Bidwell & Co., Windsor Locks	**30.00**	17.67
			W. B. Martin, Rockville	30.00	
10287	E. Frank Coe's Celebrated Special Potato Fertilizer	E. Frank Coe Co., N. Y.	A. L. Burdick, Westbrook	**32.00**	18.61
			J. R. Babcock, Old Mystic	32.00	
10301	Berkshire Potato and Vegetable Phosphate	Berkshire Fertilizer Co., Bridgeport	J. W. Palmer, Stamford	32.00	17.43
			Manufacturer	**30.00**	
			Johnson Bros., Jewett City	30.00	
10257	Lister's Corn and Potato Fertilizer	Lister's Agricultural Chemical Works, Newark, N. J.	A. W. Hutchinson, Gilead	**32.00**	18.57
10266	E. Frank Coe's Columbian Corn Fertilizer	E. Frank Coe Co., N. Y.	J. R. Babcock, Old Mystic	32.00	17.94
			A. L. Burdick, Westbrook	30.00	
				31.00	
9996	Bradley's Potato Fertilizer	American Agricultural Chemical Co., N. Y.	Wilson & Burr, Middletown	32.00	17.93
			W. B. Martin, Rockville	30.00	
				31.00	
10274	Packers' Union Wheat, Oats and Clover Fertilizer	American Agricultural Chemical Co., N. Y.	Otto Ljunblad, Berlin	**23.00**	12.79

ANALYSES AND VALUATIONS—*Continued.*

Station No.	Percentage difference between cost and valuation.	NITROGEN.					PHOSPHORIC ACID.							POTASH.		
		Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen Organic.	Total Nitrogen.		Soluble.	Reverted.	Insoluble.	Total.		Available.		Found.		Guaranteed.
					Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	
10158	66.3	....	...	2.10	2.10	2.1	4.42	4.44	3.27	12.13	9.0	8.86	8.0	1.72	1.72	1.5
9988	66.7	3.35	0.72	0.13	4.20	3.9	3.10	2.52	1.29	6.91	6.0	5.62	5.0	2.48	3.03	2.0
10238	67.3	0.39	...	2.13	2.52	2.0	3.10	5.05	4.44	12.59	11.0	8.15	....	3.18	3.18	3.0
10025	69.6	0.06	...	1.96	2.02	1.8	3.46	1.86	1.29	6.61	9.0	5.32	5.0	6.05	6.05	6.0
9994	69.8	0.18	0.11	1.93	2.22	2.1	6.19	2.77	2.07	11.03	9.0	8.96	8.0	1.83	1.83	1.5
10287	72.0	....	0.43	1.50	1.93	1.7	6.98	1.87	1.26	10.11	9.5	8.85	8.0	0.69	3.82	4.0
10301	72.1	0.18	...	1.94	2.12	1.7	3.76	2.42	1.79	7.97	8.0	6.18	6.0	2.54	4.63	4.0
10257	72.3	....	0.24	1.60	1.84	1.0	7.79	2.26	2.28	12.33	9.0	10.05	8.0	1.74	2.82	3.0
10266	72.8	....	...	1.49	1.49	1.3	7.71	2.37	1.55	11.63	10.5	10.08	8.5	1.26	3.60	2.5
9996	72.9	0.33	0.05	1.82	2.20	2.1	5.68	2.65	1.81	10.14	10.0	8.33	8.0	3.08	3.08	3.0
10274	79.8	....	...	...	...	....	7.82	4.12	0.87	12.81	12.0	11.94	11.0	2.47	2.47	2.0

SPECIAL MANURES, SAMPLED BY THE STATION.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
	Sampled by Station Agent.				
10026	Sanderson's Corn Superphosphate	Sanderson Fertilizer and Chemical Co., New Haven	Manufacturer	$28.00	$15.87
			Geo. W. Eaton, Plainville	30.00	
				29.00	
9992	Bowker's Potato and Vegetable Phosphate	Bowker Fertilizer Co., N. Y.	Lightbourn & Pond Co., New Haven	32.00	16.80
			W. B. Martin, Rockville	30.00	
				31.00	
10106	Bowker's Corn Phosphate	Bowker Fertilizer Co., N. Y.	W. B. Martin, Rockville	30.00	15.90
			Seth Viets, Suffield	29.00	
				29.50	
10529	Wheeler's Grass and Oats Fertilizer	American Agricultural Chemical Co., N. Y.	Henry S. Judd, Middlebury	24.00	12.06
			A. H. Post, Gilead	22.00	
				23.00	
10159	Wheeler's Corn Fertilizer	American Agricultural Chemical Co., N. Y.	Stanton A. Winsor,* Danielson		15.72
			Henry S. Judd, Middlebury	**30.00**	
10161	Read's Practical Potato Special	American Agricultural Chemical Co., N. Y.	O. Russ, Mt. Hope	30.00	15.17
			J. A. Nichols & Co., Danielson	32.00	
			L. A. Fenton, Norwich Town	30.00	
				30.50	
10528	Great Eastern Grass & Oats Fertilizer	American Agricultural Chemical Co., N. Y.	Elmer Keeler, Danbury	**25.00**	12.35
			Thos. J. Richmond, New Milford	25.00	
	2. *Sampled by Purchasers and others.*		*Sent by*		
10178	H. G. Tobacco Manure	American Agricultural Chemical Co., N. Y.	E. N. Austin, Suffield	44.00	35.00
10179	Chittenden's Complete Tobacco Formula	National Fertilizer Co., Bridgeport	E. N. Austin, Suffield	35.00	26.90
10542	H. G. Complete Corn and Onion‡	Rogers Mfg. Co., Rockfall	Manufacturer	34.00	26.00
10524	Bowker's Potato and Vegetable Fertilizer	Bowker Fertilizer Co., N. Y.	M. K. Northam, Stony Creek	27.00	19.69
10546	Tobacco Starter†‡	Rogers Mfg. Co., Rockfall	Manufacturer	34.00	----

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* Sample was taken at Danielson R.R. station from bags marked with this name.

† Partial analysis. ‡ See note, page 67.

ANALYSES AND VALUATIONS—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid.							Potash.		
					Total Nitrogen.					Total.		Available.		Found.		
		Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen Organic.	Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	Guaranteed.
10026	82.7	0.14	---	1.83	1.97	**1.8**	6.06	1.94	0.70	8.70	**10.0**	8.00	**7.0**	2.29	2.29	**2.0**
9992	84.5	0.45	0.11	1.50	2.06	**1.5**	3.73	4.35	2.87	10.95	**10.0**	8.08	**9.0**	2.32	2.32	**2.0**
10106	85.5	0.10	0.26	1.40	1.76	**1.7**	5.14	3.32	1.84	10.30	**9.0**	8.46	**8.0**	2.24	2.24	**2.0**
10529	90.7	----	---	---	---	----	7.68	3.76	0.79	12.23	**12.0**	11.44	**11.0**	2.14	2.14	**2.0**
10159	90.8	----	---	1.64	1.64	**1.7**	5.68	2.43	2.14	10.25	**9.0**	8.11	**8.0**	2.62	2.62	**2.0**
10161	101.1	0.03	---	0.97	1.00	**0.8**	2.42	2.14	2.23	6.79	**5.0**	4.56	**4.0**	8.24	8.24	**8.0**
10528	102.4	----	---	---	---	----	8.26	3.05	1.46	12.77	**11.0**	11.31	**9.0**	2.24	2.24	**2.0**
10178	25.7	----	2.01	3.53	5.54	**5.5**	3.90	2.47	1.57	7.94	**6.0**	6.37	**5.0**	1.46	10.06	**10.0**
10179	30.1	----	0.60	3.14	3.74	**3.3**	7.52	1.89	1.03	10.44	**10.0**	9.41	---	0.76	5.54	**6.0**
10542	30.8	1.51	0.08	2.15	3.74	**3.6**	3.86	3.04	2.03	8.93	**8.0**	6.90	**6.0**	8.44	8.44	**7.0**
10524	37.1	0.74	0.15	1.41	2.30	**2.5**	6.74	2.33	1.87	10.94	**9.0**	9.07	**8.0**	4.08	4.08	**4.0**
10546	----	present	---	---	3.16	**2.5**	none	4.80	6.24	11.05	**8.0**	4.80	**6.0**	----	6.66	**5.0**

An inspection of the tables of analyses shows that the number of pounds of nitrogen, phosphoric acid and potash purchasable for $30 in those special manures were as follows:

	Ton price.	Nitrogen.	Available phosphoric acid.	Potash.
In the first 11 samples in the table	$38.73	80	106	141
" next 13 " " "	39.90	64	112	156
" " 10 " " "	37.95	58	110	128
" " 11 " " "	33.55	54	148	126
" " 10 " " "	32.20	54	151	92
" " 9 " " "	31.33	48	156	115
" " 11 " " "	31.80	47	163	85
" " 10 " " "	30.55	42	162	80
" " 11 " " "	25.73	48	195	77
" " 7 " " "	25.00	29	205	76

This statement, which is wholly independent of any Station "valuation," shows clearly that dollar for dollar the buyer gets more than twice as much plant food in special manures which cost from $38.00 to $40.00 per ton than in those which he can buy for $25.00.

It also shows that the goods which are "cheap" are made cheap by taking out nitrogen and potash and loading up with phosphate.

A half ton of fertilizer may be bought for $20.00, which will contain two and one-half times as much nitrogen, nearly twice as much potash and half as much phosphoric acid as a ton of other brands of specials costing $25.00.

These figures, along with those given on page 48, should be borne in mind by those who are considering the purchase of mixed fertilizers, and are tempted by low selling prices.

Tobacco Manures Claimed to contain Potash in Form of Carbonate or Nitrate.

In the following table are ten analyses of five brands of tobacco manures which are claimed to contain potash, chiefly or wholly in form of nitrate or carbonate.

Bowker's Tobacco Ash Elements, and the Tobacco Starter Improved and Tobacco Ash Constituents made by the Mapes F. & P. G. Co., contain much more sulphuric acid than would have been introduced by the use, in their manufacture, of sulphate of potash, rather than the more expensive carbonate. Olds & Whipple's Complete Tobacco Fertilizer contains enough chlorine and sulphuric acid to combine with about two-thirds of the potash present, and Bowker's Complete Alkaline Tobacco Grower contains only enough sulphuric acid and chlorine to combine with one-third of the potash. The presence of sulphuric acid and chlorine, even in considerable amount, does not, however, in any way disprove the statement of the manufacturers that the potash in the mixture was introduced as carbonate, for both sulphuric acid and chlorine may have come from other articles used in the mixture, such as acid phosphate, acid fish or whatever else may have been employed along with carbonate of potash. All these mixtures have a strong alkaline reaction.

The valuation of these fertilizers given in the table is calculated like that of other mixed fertilizers. Sufficient potash to combine with all the chlorine and sulphuric acid present is reckoned as muriate and sulphate at 4¼ and 5 cents per pound respectively, and any potash in excess is reckoned at 8 cents per pound, as carbonate. If, instead, all the water-soluble potash were reckoned as carbonate at 8 cents per pound, the valuation per ton of Bowker's Tobacco Ash Elements would be $31.22, of Bowker's Alkaline Tobacco Grower, $28.04, of Mapes' Tobacco Ash Elements, $33.10 and of Olds & Whipple's Complete Tobacco Fertilizer an average of $31.32. For remarks on the use of carbonate of potash in tobacco fertilizers, see page 31.

10085. Bowker's Tobacco Ash Elements, made by Bowker Fertilizer Co., New York. Stock of Theo. H. Hauser, Suffield.

10086. Bowker's Complete Alkaline Tobacco Grower, made by Bowker Fertilizer Co., New York. Stock of Bowker's Branch, Hartford.

10087. Mapes' Tobacco Starter, Improved, made by Mapes F. & P. G. Co., New York. Stock of Spencer Bros., Suffield, and of F. S. Bidwell & Co., Windsor Locks.

10089. Mapes' Tobacco Ash Constituents, made by Mapes F. & P. G. Co., New York. Stock of Spencer Bros. Suffield, and of F. S. Bidwell & Co., Windsor Locks.

Six samples of Olds & Whipple's Complete Tobacco Fertilizer, made by Olds & Whipple, Hartford, drawn by the Station agent from the following persons:

10079. Stock of Charles A. Jackson, Suffield.
10080. Stock of Joseph Adams, Suffield.
10081. Stock of J. W. Wallace & Sons, Suffield.
10082. Stock of W. S. Pinney, Suffield.
10083. Stock of Charles Pomeroy, Suffield.
10084. Stock of E. A. Hathaway, R. D., Suffield.

10217. An Experimental Mixture for Tobacco. Stock of W. J. Cox, East Hartford.

ANALYSES AND VALUATIONS.

	Bowker's Tobacco Ash Elements.	Bowker's Complete Alkaline Tobacco Grower.	Mapes' Tobacco Starter Improved.	Mapes' Tobacco Ash Constituents.	Olds and Whipple's Complete Tobacco Fertilizer.						Experimental Mixture.
Percentage amounts of	10085	10086	10087	10089	10079	10080	10081	10082	10083	10084	10217
Nitrogen as nitrates	....	1.18	3.19	0.05	....	....	....	....	....	....	0.82
" as ammonia	....	....	0.12	0.08	....	...	....	....	....	....	....
" organic	....	3.50	0.95	0.75	5.24	5.43	5.29	5.15	5.32	5.37	3.35
" total found	....	4.68	4.26	0.88	5.24	5.43	5.29	5.15	5.32	5.37	4.17
" total guaranteed	....	4.00	4.12	0.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50
Phosphoric acid, soluble	0.11	0.37	2.80	....	0.35	0.24	0.27	0.08	0.35	0.27	1.06
" " reverted	8.24	3.65	3.55	2.70	3.61	3.82	3.66	3.45	3.42	3.55	5.75
" " available found	8.35	4.02	6.35	2.70	3.96	4.06	3.93	3.53	3.77	3.82	6.81
" " " guaranteed	6.00	4.00	6.00	....	3.00	3.00	3.00	3.00	3.00	3.00	6.00
" " insoluble	1.79	4.09	2.90	3.63	2.53	2.53	2.70	3.21	2.47	2.47	2.49
" " total found	10.14	8.11	9.25	6.33	6.49	6.59	6.63	6.74	6.24	6.29	9.30
" " total guaranteed	....	5.00	8.00	5.70	....	....	....	....	....	....	7.00
Potash soluble in water	14.88	4.82	1.71	16.57	5.57	5.58	5.69	5.71	5.74	5.73	10.66
" total	14.88	5.71	1.71	16.57	6.43	6.39	6.55	6.67	6.36	6.61	....
" total guaranteed	15.0	5.00	1.20	15.00	5.50	5.50	5.50	5.50	5.50	5.50	10.00
Chlorine	0.64	0.44	0.66	0.70	1.08	1.12	1.14	0.76	1.12	1.12	0.43
Sulphuric acid	20.45	0.82	12.74	19.97	2.40	2.40	2.37	1.49	2.38	2.36	13.45
Cost per ton	$30.00	34.00	35.00	32.00	35.00	35.00	35.00	35.00	35.00	35.00	....
Valuation per ton	$22.16	26.54	21.32	23.02	28.17	28.87	28.53	28.95	28.52	28.72	30.98

The analyses of some of these articles, which are unlike any of the usual brands of commercial fertilizers, have presented difficulties owing to the presence of large amounts of easily soluble organic matter together with alkaline carbonates and phosphates. In such mixtures it is scarcely possible to obtain the true percentage of water-soluble potash by following the conventional methods of the Association of Official Chemists.

Thus in analysis No. **9935** of Olds & Whipple's Complete Tobacco Fertilizer sampled from stock of C. A. Jackson, Suffield, by F. A. Chapin, Suffield, which is given below, the amount of water-soluble potash, *determined by the conventional method,* and reported to the parties interested, was 4.91 per cent. Subsequent work, however, has proved that this figure, obtained by strictly following the standard methods of analysis, was too low and the amount actually present was 5.68 per cent.

The corrected analysis is given below, with the potash calculated as in all the other analyses and potash as carbonate valued at 8 cents per pound, to correspond with present ruling rates, instead of 7¼ cents.

ANALYSIS.

	9935
Organic nitrogen	5.16
Nitrogen guaranteed	4.50
Phosphoric acid, soluble	none
" " "reverted"	5.07
" " insoluble	1.77
" " available found	5.07
" " " guaranteed	3.00
Potash soluble in water	5.68
" total	6.84
" " guaranteed	5.50
Chlorine	0.98
Sulphuric acid	2.38
Cost per ton	$35.00
Valuation per ton	28.75

HOME MIXTURES.

In the following table, pages 90 and 91, are analyses of ten samples of fertilizers prepared by farmers from fertilizer chemicals purchased in New York or in Connecticut. The samples were in most cases taken by the makers of the mixtures and sent to the Station for analysis.

HOME MIXTURES. FORMULAS,

Station No.	Made by	Formulas. Pounds per Ton of							
		Nitrate of Soda.	Sulphate of Ammonia.	Cotton Seed Meal.	Tankage.	Acid Phosphate.	Dissolved Bone Black.	High Grade Sulphate of Potash.	Double Sulphate Potash and Magnesia.
10168	P. K. Hoadley, Guilford	150	----	150	1300	----	----	----	----
10022	Conn. School for Boys, Meriden	500	----	----	500	400	----	----	----
10021	Conn. School for Boys, Meriden	100	----	----	750	750	----	----	200
10052	The E. B. Clark Co., Milford	----	----	----	----	----	----	----	----
10050	The E. B. Clark Co., Milford	----	----	----	----	----	----	----	----
9966	S. D. Woodruff & Sons, Orange	----	----	----	----	----	----	----	----
9970	S. D. Woodruff & Sons, Orange	----	----	----	----	----	----	----	----
10227	Willis M. Nettleton, Washington Dep.	200	----	300	400	500	200	400	----
10199	Andrew Ure, Highwood	----	----	----	.	----	----	----	----
9818	S. D. Woodruff & Sons, Orange	150	100	----	500	700	200	----	----

As regards mechanical condition and chemical composition these fertilizers are in no respect inferior to factory mixed goods.

The mixtures show a considerable range of composition. The average composition of the ten is:

Nitrogen	3.86
Available phosphoric acid	7.74
Potash	7.56

The average cost reported was $21.60. In some cases this probably only covers cost of the raw materials, which in most cases were bought for cash in mixed car lots, that is, at approximately wholesale prices.

But even assuming that the average cost of these mixtures to one who bought his unmixed chemicals at reasonable retail rates was the same as that of the average factory mixed nitrogenous superphosphate, $30.39, the home mixtures would supply a good deal more plant food *per dollar* than the factory mixed goods as appears in the following statement:

	Nitrogen, pounds.	Available phosphoric acid, pounds.	Potash, pounds.
$30 in a home mixture buys	76	152	149
$30 in the average factory mixed nitrogenous superphosphate buys	54	160	89

ANALYSES AND VALUATIONS.

MIXTURE.		ANALYSES.									COST (UNMIXED) AND VALUATION.		
Muriate of Potash.	Kainit.	Nitrogen as Nitrates.	Nitrogen as Ammonia.	Organic Nitrogen.	Total Nitrogen.	Soluble Phosphoric Acid.	Reverted Phosphoric Acid.	Insoluble Phosphoric Acid.	Total Phosphoric Acid.	Potash.	Cost per ton.	Valuation per ton.	Percentage difference between cost and valuation.
400	....	0.93	0.14	4.07	5.14	0.29	6.54	2.79	9.62	10.79	$27.20	$32.90	17.3*
250	350	3.90	....	1.51	5.41	2.59	2.85	1.33	6.77	8.81	27.88	29.46	5.4*
200	....	0.78	...	2.12	2.90	4.70	4.09	2.61	11.40	7.87	23.96	24.87	3.7*
...	....	1.32	....	2.38	3.70	7.20	2.22	1.34	10.76	7.33	28.00	27.08	3.4
....	....	1.11	0.20	1.91	3.22	5.10	3.12	2.45	10.67	6.22	25.00	23.88	4.7
....	....	0.90	0.12	1.40	2.42	5.36	2.89	0.68	8.93	7.75	26.50	21.87	21.2
....	...	0.98	0.16	1.24	2.38	5.65	2.62	0.51	8.78	7.57	26.50	21.54	23.0
...	....	1.30	...	2.26	3.56	3.28	2.26	1.29	6.83	6.39	31.00	23.18	33.7
...	....	2.16	....	3.05	5.21	2.93	3.87	3.88	10.68	4.58	....	28.03	...
350	....	1.13	1.40	2.13	4.66	5.23	4.68	1.39	11.30	8.29	....	31.59	....

* Valuation exceeds cost.

TOBACCO STEMS.

The midribs or "stems" of tobacco leaves from tobacco factories are much used as a fertilizer for tobacco and sometimes as a top dressing for lawns.

10155. Sent by C. S. Phelps, Chapinville.

Moisture	23.40
Nitrogen	1.92
Phosphoric acid	0.55
Potash	5.66

VEGETABLE ASH AND ASH COMPOUNDS.

Under these names a number of mixtures are in market claimed to be made chiefly or exclusively of the ashes of various vegetable matters and to contain potash chiefly in the form of carbonate. Six analyses have been made with the following results.

10251 and **10074.** Bowker's Twenty-five per cent. Ash Compound, made by Bowker Fertilizer Co., New York; 10251 from stock of Bowker's Branch, Hartford; 10074 from stock bought by T. L. Kenney, Windsor, of Seth Viets, West Suffield.

10228 and **10250.** Vegetable Potash, sold by Olds & Whipple, Hartford; 10228, sampled and sent by R. W. Griffin, Granby; 10250, from stock of Olds & Whipple, Hartford, and of D. L. Brockett, Suffield.

10215 and **10543.** Twenty-five per cent. Potash from Vegetable Sources. Sold by the Rogers Manufacturing Co., Rockfall; No. 10215, bought by C. F. Tilden, Suffield, from Arthur Sikes, Suffield; No. 10543, sent by Rogers Manufacturing Co.

The Rogers Manufacturing Co. was disappointed in the analysis of sample **10215,** because the percentage of potash found, 23.92, fell below the guaranteed amount, 25.0.

At the request of the manufacturer a second sample was examined, **10543,** which was drawn by the manufacturer from stock mixed some weeks before. The percentage of potash was less than in the first sample.

ANALYSES.

	Bowker Fertilizer Co.		Olds & Whipple.		Rogers Manufacturing Co.	
	10251	10074	10228	10250	10215	10543
Percentage amounts of						
Phosphoric acid	....	....	....	....	1.38	2.25
Total potash	23.93	23.78	25.87	25.37	23.92	....
Water-soluble potash	22.94	23.60	25.49	24.96	23.69	21.74
Chlorine	0.74	0.69	2.55	2.42	3.82	4.01
Sulphuric acid	15.87	17.48	3.95	3.74	5.47	6.21
Cost per ton	$40.00	42.00	40.00	40.00	40.00	40.00
Water-soluble potash costs cents per pound	8.7	8.9	7.8	8.0	8.4	9.2

The two samples of Olds & Whipple's manufacture contain the guaranteed percentage of potash; the others do not. Potash in these articles costs as much as or more than in form of pure carbonate of potash, from 7.8 to 9.2 cents per pound. The goods find their chief use as tobacco fertilizers by growers who wish to avoid muriates and sulphates. The 25 Per cent. Ash Compound of the Bowker Co. contains enough sulphuric acid to combine with the larger part of the potash present in it. There would seem to be no possible advantage in using carbonate of potash on tobacco if with it there is mixed an equivalent quantity of sulphates of soda, lime, or other base. It would be more economical and probably no more harmful to the quality of the crop to use sulphate of potash. See remarks on this subject on page 31.

ASHES OF TOBACCO STALKS.

10077. Sent by W. I. Stevens & Sons, Hockanum. Left from burning in the field the stalks of Connecticut Havana tobacco.

The ashes contain 3.33 per cent. of phosphoric acid and 17.29 per cent. of water-soluble potash and are well worth saving and using as tobacco fertilizer.

The stalks from an acre of tobacco contain, on the average, 32 pounds of nitrogen, 49 of potash and 13 of lime. Nearly one-third of the nitrogen and potash in a tobacco crop is contained in the stalks.

COTTON HULL ASHES.

This material, once so much used as a tobacco fertilizer, has gone out of market and cannot now be bought in large amounts, as formerly.

Its place has been taken by the ashes of beet molasses and the pure carbonate of potash described on page 30 of this report.

Six samples of cotton hull ashes have been examined this year, as follows:

9924. Made by Cotton Oil and Fiber Co., Norfolk, Va. Stock of Olds & Whipple, Hartford.

10551. Made by American Cotton Oil Co., New York. Sent by Spencer Bros., Suffield.

9925. Made by Cotton Oil and Fiber Co., Norfolk, Va. Stock of Olds & Whipple, Hartford.

10545. Stock of W. F. Fletcher, Southwick, Mass. Sampled from twenty-five sacks and sent by J. B. Cannon, Granby.

10556. Stock of W. F. Fletcher, Southwick, Mass. Sampled and sent by Alfred H. Griffin, Granby.

9971. Made by American Cotton Oil Co., New York. Stock of Spencer Brothers, Suffield. Sent by Geo. A. Peckham, Suffield.

ANALYSES OF COTTON HULL ASHES.

Percentage amounts of	9924	10551	9925	10545	10556	9971
Phosphoric acid, water-soluble	3.07	1.17	1.20	0.14	1.42	0.94
" " citrate-soluble	5.65	10.00	4.96	6.01	7.09	9.24
" " insoluble	1.19	0.31	0.33	1.13	1.10	1.35
Potash, total	28.20	26.28	24.92	21.90	21.90	24.52
Of which, soluble in water	26.15	22.92	22.54	19.38	17.18	19.96
Chlorine	0.26	....	0.41	0.32	0.10	0.03
Sulphuric acid	3.01	....	5.30	2.55	2.61	1.05
Cost per ton	$40.00	40.00	40.00	40.00	41.00	....
Potash costs cents per pound	6.2	6.7	7.7	8.9	9.8	....

Valuing water-soluble, citrate-soluble and insoluble phosphoric acid at 4½, 4 and 2 cents a pound, respectively, the potash in these samples, which is chiefly in form of carbonate, costs from 6.2 to 9.8 cents per pound.

WOOD ASHES.

In a following table, pages 96 and 97, are given thirty-three analyses of materials called "wood ashes." It is quite clear, however, that samples **10058, 10076, 10177,** and **10154,** are not unleached hardwood ashes, while the other samples may be. Ashes are generally represented and sold in the state as "Canada, hardwood, unleached ashes."

The analyses given show the very wide range of composition common in different consignments of Canada ashes. Thus, excluding the samples named, the percentage of total potash ranges from 9.19 to 3.83 and that of lime from 48.33 to 20.93.

Excluding the four samples above named, the other twenty-nine have the following average composition:

Potash soluble in acid	5.86
Potash soluble in water	5.17
Phosphoric acid	1.33
Lime	29.23

The percentages of potash are considerably higher than last year; the percentage of lime is about two per cent. lower.

The average price, $11.84 per ton, is $1.84 higher than last year. If the water-soluble potash is valued at 8 cents, as in carbonate, and the phosphoric acid at 4 cents, lime in ashes of average composition has cost 43 cents per 100 pounds.

LIME KILN ASHES.

A single sample, **9808**, made by the New England Lime Co., of New Milford, sent for analysis by E. O. Marsh, of New Milford, had the following composition:

Percentage amounts of	
Water-soluble potash	2.87
Acid-soluble potash	3.40
Lime	41.68
Magnesia	8.12
Phosphoric acid	1.42
Sulphuric acid	0.18
Chlorine	none
Sand	1.58
Charcoal	0.14

The price was $8.00 per ton.

OYSTER SHELL LIME.

Two samples of this material, Nos. **9752** and **9794**, made by H. A. Stevens Coal Co., New Haven, and sent by them for analysis, contained:

	9752	9794
Sand	....	3.07
Lime	59.33	65.39
Magnesia	....	0.55
Sulphuric acid	....	0.62

SHEEP MANURE.

This material, gathered in corrals in the grazing regions and unavoidably more or less leached by exposure to rain, may be of considerable value to mix with earth for potting plants in the greenhouse, but at the prices quoted cannot be economically used as a fertilizer on the farm.

9967. Sampled from stock of S. D. Woodruff & Sons, Orange.

10241. Sold by Stockdale Fertilizer Co., Stockdale, Ill. Price about $13.80 in Connecticut. Sent by J. C. Mitchelson, Tariffville.

WOOD ASHES.

Station No.	Dealer or Purchaser.	Sampled or sent by
9774	H. C. Aborn & Son, Ellington	H. C. Aborn & Son, Ellington
9882	Bowker's— F. S. Bidwell & Co., W. Locks	F. S. Bidwell & Co., W. Locks
9958		F. M. Thompson, Warehouse Pt.
9985		Seth Viets, W. Suffield
10042	Bowker Fertilizer Co., Boston	W. M. Cooper, Suffield
10058	F.R.Lalor,Dunnville,Ont.,Can.	G. E. Norton, Bristol
10075	Seth Viets, W. Suffield	Thos. L. Kenney, R. D. 2, Suffield
10076		Seth Viets, W. Suffield
10177		Bowker Fertilizer Co., Hartford
10252	Lightbourn&PondCo.,N.Haven	Station Agent
	Seth Viets, W. Suffield	
	A. I. Martin, Wallingford	
	Newell St. John, Simsbury	
10864		D. N. Clark, Bethany
9826	J. W. Gardner, Cromwell	A. N. Pierson, Cromwell
9820	Joynt's—	John Joynt, Lucknow, Ont., Can.
9847	F. S. Bidwell & Co., W. Locks	Wm.W.Thompson,Warehouse Pt.
9862	" "	Clayton Holdridge, Suffield
9863	" "	D. I. King, Suffield
9864		Chas. V. Chandler, So. Windsor
9865		" "
9872		E. P. Brewer, Silver Lane
9880	F. S. Bidwell & Co., W. Locks	F.S.Bidwell & Co.,Windsor Locks
9881	" "	" "
9920	" "	" "
9926	Olds & Whipple, Hartford	Station Agent
9927	" "	"
9943		Conn. Valley Orchard Co., Berlin
9944		" "
10002		A. N. Graves, Suffield
9751	Wm. P. Perkins, Brooklyn, N.Y.	Stonecrest Farm, W. W. Robison, Mgr., Ridgefield
9942	Stroup, Son & Co., Boston, Mass.	Conn. Valley Orchard Co., Berlin
10154	" "	" "
10156	" "	" "
9833		TheWarner-MillerCo.,NewHaven
9781		Geo. I. Babcock, Bethany

ANALYSES.

	9967	10241
Percentage amounts of		
Water	11.32	----
*Organic matters	75.61	----
†Ash or mineral	13.07	----
	100.00	

PERCENTAGE COMPOSITION.

Potash soluble in acid.	Potash soluble in water.	Phosphoric acid.	Lime, calcium oxide.	Magnesia.	Chlorine.	Sand and soil.	Charcoal.	Sulphuric acid.	Cost per ton.
5.13	4.24	1.66	27.30	2.77	0.11	12.39	1.19	0.53	$10.00
6.29	5.67	1.45	34.24	2.68	0.14	8.08	1.25	0.83	13.50
7.69	6.80	1.34	26.97	4.03	0.21	9.52	1.51	1.14	9.25
4.01	3.11	1.04	27.52	2.24	0.08	11.69	1.84	1.42	10.50
5.82	4.97	1.83	25.18	2.36	0.22	7.11	1.05	0.59	10.00
2.06	1.68	0.99	24.33	7.88	0.08	4.49	1.26	0.28	9.25
5.24	4.68	1.39	27.20	7.81	0.15	6.66	0.77	0.85	10.50
3.72	2.75	1.45	23.21	2.63	0.12	16.30	2.15	0.52	....
2.56	1.84	0.93	27.03	6.21	0.06	5.04	1.45	0.34	9.25
5.39	4.81	1.56	30.89	2.81	0.16	7.60	1.63	0.98	10.00
....	....	....	....	....	....	....	....	....	10.50
....	....	....	....	....	....	....	....	....	11.00
...	....	....	...	....	...	....	....	....	10.00
4.12	3.49	1.14	33.38	3.43	0.20	9.81	1.49	0.97	9 25
5.53	4.89	1.52	34.35	3.50	0.14	11.89	1.90	0.64	10.00
9.19	8.52	1.82	38.30	3.54	0.23	5.31	1.24	0.89	....
4.64	4.18	1.11	22.18	2.20	0.12	18.60	3.05	2.89	12.00
7.30	6.90	1.24	26.89	2.74	0.25	6.00	0.92	0 94	12.00
8.03	7.60	1.29	27.95	3.37	0.48	4.23	0.83	0.88	12.00
5.07	4.78	1.33	22.80	3.43	0.20	12.09	2.68	1.84	11.00
5.05	4.61	1.16	24.39	2.54	0.20	17.93	2.95	2.75	11.00
6.08	5.61	1.36	24.69	3.84	0.09	11.85	1.34	1.21	12.00
6.85	6.22	1.09	22.81	2.33	0.10	15.64	2.44	2.85	12.00
4.77	4.29	1.03	20.93	2.84	0.13	17.13	2.90	2.90	12.00
7.18	5.59	1.20	25.88	2.49	0.18	8.46	1.97	2.15	12.00
6.65	5.00	1.25	29.53	2.53	0.69	10.70	1.12	1.23	10.00
7.27	6.40	1.22	31.14	3.65	0.17	8.83	2.03	1.32	10.00
7.09	6.10	1.34	37.86	4.04	0.14	4.58	1.61	0.74	9.00
4.10	3.64	1.28	23.06	4.88	0.13	9.09	1.55	0 76	9.00
5.88	4.89	1.22	27.10	2.27	0.17	11.05	1.24	0.79	12.00
3.83	3.45	1.16	37.48	3.74	trace	4.41	0.60	0.50	9.00*
6.72	6.22	1.23	22.52	7.67	0.16	7.13	1.50	0.88	10.00
3.81	3.19	1.18	26.27	9.26	0.07	5.76	1.60	0.45	9.50
5.43	4.80	1.23	35.36	4.20	0.16	6.32	1.36	0.89	....
5.09	4.57	1.90	48.33	8.66	none	1.68	0.29	0.30	11.00
4.43	4.00	1.24	31.26	5.05	0.22	9.09	1.80	1.02	9.25

* In car lots.

*Containing nitrogen	2.74	2.34
†Containing phosphoric acid	1.46	1.38
Potash	1.53	1.41
Sand and soil	6.35	....

Four other samples sent by the Elm City Nursery Co. contained 1.94, 2.75, 2.64 and 2.52 per cent. of nitrogen respectively.

GARBAGE TANKAGE.

The samples referred to below represent material made of city garbage collected in Bridgeport and cooked and dried by a patented process, operated by Plumb & Winton, Bridgeport.

9832. Sent by Frank S. Staples. **9953.** Sent by T. A. Kirkham, sampled by A. H. Chamberlain, all of Bridgeport.

ANALYSES OF GARBAGE TANKAGE.

	9832	9953
Percentage amounts of		
Nitrogen	2.17	2.07
Phosphoric acid	4.08	....
Moisture	6.40	....

The composition of such material will vary greatly according to the extent to which the drying is carried, and dried garbage also varies considerably in composition with the season of the year.

COCOANUT PITH.

10015. This material, used by florists for packing bulbs, was sent by E. E. Burwell, New Haven, who stated that it is made by the West India Fiber Co., Salem, Mass., and inquired whether it had value as a fertilizer.

ANALYSIS.

Percentage amounts of	
Moisture	10.03
*Organic and volatile matter	84.92
†Mineral matter	5.05
	100.00

It is probable that the nitrogen of cocoanut pith is not readily soluble and available and the material is not of any value as a commercial fertilizer.

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*Containing nitrogen 0.42.

†Containing phosphoric acid 0.15, and potash 1.53.

REVIEW OF THE FERTILIZER MARKET,

FOR THE YEAR ENDING OCTOBER 31, 1903.

BY E. H. JENKINS.

NITROGEN.

Nitric Nitrogen.

The *wholesale* New York quotation of nitrogen in form of nitrate, which was 12.5 cents per pound in November, 1902, has risen on the whole, the average quotation for the six months ending with August, 1903, being 13.3 and the quotation in October being 13.8.

The average of the monthly quotations for a number of years —from November 1st to November 1st—has been as follows:

Year	1903	1902	1901	1900	1899	1898	1897	1896
Average quotation, cents per pound for nitrogen, *wholesale*	13.2	13.4	11.9	11.8	10.5	11.0	11.4	11.1

Nitrate nitrogen has been sold to farmers in this state during the past season for from 14.2 to 15.9 cents per pound, or from $45.00 to $50.00 per ton for nitrate of soda.

Ammonic Nitrogen.

The *wholesale* New York quotation of nitrogen in this form was 14.2 cents per pound in November, 1902. It rose steadily to 15.4 in April and then declined, being quoted at 14.6 cents in October.

The average monthly quotations for a number of years have been as follows:

Year	1903	1902	1901	1900	1899	1898	1897	1896
Average quotation, cents per pound for nitrogen, *wholesale*	14.9	14.2	13.3	13.9	14.0	11.9	10.5	11.1

Scarcely any sulphate of ammonia is used by farmers for home mixing, as the present price is prohibitive for use as a fertilizer. It has been quoted at retail in Connecticut at $70 per ton, making the cost 16.8 cents per pound.

Organic Nitrogen.

The *wholesale* New York quotation of nitrogen in form of red blood, which was 14.8 cents per pound in November, 1902, rose steadily to 16.3 in April, 1903, and then declined again, being 15.6 cents per pound in October. It has ruled about a cent per pound higher than in the previous year.

Concentrated tankage has been quoted through the year at $15.50 per ton.

Dry Fish, quoted at $27.50 per ton in November, 1902, was quoted at $25.12 in November, 1903.

Nitrogen in form of cotton seed meal has cost the same as last year, 16 cents per pound at retail.

Phosphatic Materials.

The *wholesale* New York quotations of Charleston rock, f.o.b. Charleston, have fallen very much during the year.

The *wholesale* New York quotations of both ground bone and bone meal have risen, the former being $1.25, the latter $3.50 per ton higher than a year ago.

The *wholesale* quotations of acid phosphate have also risen from 3.12 cents per pound for available phosphoric acid to 3.19 cents.

We again call attention to the fact that farmers who buy acid phosphate are in many cases paying high prices for it and that prospective purchasers of considerable amounts would do well to get quotations from a number of brokers before purchasing.

Potash.

The *wholesale* quotations of potash salts, which are regulated within narrow limits by the German Kali works, show but little fluctuation. In March the syndicate fixed the prices for the coming year, which are somewhat higher than before.

Muriate of Potash.

The *wholesale* New York price, as fixed by the syndicate, is 3.74 cents per pound for potash, about a tenth of a cent higher than in the previous year.

At retail in this state, potash as muriate has cost from 4.0 to 4.7 cents per pound.

Double Sulphate of Potash and Magnesia.

The *wholesale* New York price since March last has been 4.28 cents per pound for potash, about a tenth of a cent higher than in the previous year. At retail it has cost about 5.1 cents per pound in Connecticut.

High Grade Sulphate of Potash.

The *wholesale* New York price of potash in this form since March has been 4.36 cents and it has been bought at retail in this state at prices ranging from 4.8 to 5.6 cents per pound.

EXPLANATIONS OF MARKET QUOTATIONS.

The following explanations will help in the examination of the market quotations, and will also show the basis on which they have been interpreted in this review:

Phosphate rock, kainit, bone, fish-scrap, tankage and some other articles are commonly quoted and sold by the ton. The seller usually has an analysis of his stock, and purchasers often control this by analysis at the time of the purchase.

Acid phosphate is usually quoted at so much "per unit" of "available"—that is, soluble and reverted—phosphoric acid. The meaning of the term "unit" is explained below. Tankage is sometimes sold with a quotation "per unit of bone phosphate." The amount of bone phosphate may be calculated by multiplying the amount of phosphoric acid by 2.18. On the other hand, the amount of phosphoric acid is calculated from bone phosphate by multiplying the latter by the decimal 0.459.

Sulphate of ammonia, nitrate of soda and the potash salts are quoted and sold by the pound, and generally their wholesale and retail rates do not differ very widely.

Blood, azotin and concentrated tankage are quoted at so much "per unit of ammonia." To reduce ammonia to nitrogen, multiply the per cent. of ammonia by the decimal 0.824 (or multiply the per cent. of ammonia by 14 and divide that product by 17). A "unit of ammonia" is one per cent., or 20 pounds per ton. To illustrate: if a lot of tankage has 7.0 per cent. of nitrogen, equivalent to 8.5 per cent. of ammonia, it is said to contain 8½ units of ammonia, and if quoted at $2.25 per unit, a ton of it will cost 8½×2.25=$19.13.

Tankage and fish scrap are sometimes sold at a price, based on analysis, which regards both the nitrogen and phosphoric acid which the product in question contains.

For example: "Tankage, 9 & 20, quoted at 2.49 and 10 per unit," means that a given lot of tankage contains somewhere in the neighborhood of 9 units of ammonia and 20 units of bone phosphate and is offered at $2.49 per unit of ammonia and 10 cents per unit of bone phosphate.

A unit of ammonia, twenty pounds, is equivalent to (20×0.824=) 16.5 pounds of nitrogen, and is quoted at $2.49. One pound of nitrogen therefore costs $(\frac{2.49}{16.5}=)$ 15.1 cents.

A unit of bone phosphate, twenty pounds, is equivalent to (20×0.459=) 9.16 pounds of phosphoric acid and is quoted at 10 cents. One pound of phosphoric acid therefore costs $(\frac{10}{9.16}=)$ 1.1 cents.

Hence it appears that in a tankage containing 9 per cent. of ammonia and 20 of bone phosphate and quoted at "2.49 and 10 per unit" the nitrogen costs 15.1 cents per pound and the phosphoric acid 1.1 cents per pound.

The cost of such a tankage will be that of 9 units of ammonia at $2.49 per unit, $22.41, plus that of 20 units of bone phosphate at 10 cents per unit, $2.00, or $24.41 per ton.

The term "ammonia" is *properly* used only in those cases where the nitrogen actually exists in the form of ammonia, but it is a usage of the trade to reckon all nitrogen, in whatever form it occurs, as ammonia.

To facilitate finding the actual cost of nitrogen per pound from the cost per unit of ammonia in the market reports, the following table is given:

Ammonia at	$3.00	per unit is	equivalent to	nitrogen at	18.2	cts. per lb.
"	2.90	"	"	"	17.6	"
"	2.80	"	"	"	17.0	"
"	2.70	"	"	"	16.4	"
"	2.60	"	"	"	15.8	"
"	2.50	"	"	"	15.2	"
"	2.40	"	"	"	14.6	"
"	2.30	"	"	"	14.0	"
"	2.20	"	"	"	13.4	"
"	2.10	"	"	"	12.8	"
"	2.00	"	"	"	12.2	"
"	1.90	"	"	"	11.6	"
"	1.80	"	"	"	11.0	"
"	1.70	"	"	"	10.3	"

Commercial Sulphate of Ammonia contains about 20.8 per cent. of nitrogen, though it varies somewhat in quality. With that per cent. of nitrogen (equivalent to 25.25 per cent. of ammonia),

if quoted at	3.3	cents per pound,	Nitrogen	costs	15.9	cents per lb.
"	3.2	"	"	"	15.4	"
"	3.1	"	"	"	14.9	"
"	3.0	"	"	"	14.4	"
"	2.9	"	"	"	13.9	"
"	2.8	"	"	"	13.4	"
"	2.7	"	"	"	12.9	"
"	2.6	"	"	"	12.5	"
"	2.5	"	"	"	12.0	"

Commercial Nitrate of Soda averages 93.7 per cent. of pure sodium nitrate, or 15.7 per cent. of nitrogen.

If quoted at	2.5	cents per pound,	Nitrogen	costs	15.9	cents per lb.
"	2.4	"	"	"	15.3	"
"	2.3	"	"	"	14.7	"
"	2.2	"	"	"	14.0	"
"	2.1	"	"	"	13.3	"
"	2.0	"	"	"	12.7	"
"	1.9	"	"	"	12.1	"
"	1.8	"	"	"	11.5	"
"	1.7	"	"	"	10.8	"
"	1.6	"	"	"	10.2	"
"	1.5	"	"	"	9.6	"

Commercial Muriate of Potash usually contains 50½ per cent. of "actual potash," or potassium oxide.

If quoted at	2.20	cents per pound,	Potassium Oxide	costs	4.35	cents per lb.
"	2.15	"	"	"	4.25	"
"	2.10	"	"	"	4.15	"
"	2.05	"	"	"	4.06	"
"	2.00	"	"	"	3.96	"
"	1.95	"	"	"	3.86	"
"	1.90	"	"	"	3.76	"
"	1.85	"	"	"	3.66	"
"	1.80	"	"	"	3.56	"
"	1.75	"	"	"	3.46	"
"	1.70	"	"	"	3.36	"

High Grade Sulphate of Potash, as it is found in the Connecticut market, contains about 49.2 per cent. of actual potash.

If quoted at	2.50	cents per pound,	Potassium Oxide	costs	5.1	cents per lb.
"	2.45	"	"	"	5.0	"
"	2.40	"	"	"	4.9	"
"	2.35	"	"	"	4.8	"
"	2.30	"	"	"	4.7	"
"	2.25	"	"	"	4.6	"
"	2.20	"	"	"	4.5	"
"	2.15	"	"	"	4.4	"
"	2.10	"	"	"	4.3	"
"	2.05	"	"	"	4.2	"
"	2.00	"	"	"	4.1	"

The Double Sulphate of Potash and Magnesia has about 26½ per cent. of potassium oxide.

If quoted at	1.00	cent	per pound,	Potassium Oxide	costs	3.77	cents per lb.
"	1.05	cents	"	"	"	3.96	"
"	1.10		"	"	"	4.15	"
"	1.15		"	"	"	4.34	"
"	1.20		"	"	"	4.53	"
"	1.25		"	"	"	4.72	"
"	1.30		"	"	"	4.90	"

The following table shows the fluctuations in the wholesale prices of a number of fertilizing materials in the New York market, since November, 1897. The price given for each month is the average of the four weekly quotations for that month. Sulphate of ammonia is assumed to contain 20.8 per cent. and nitrate of soda 15.7 per cent. of nitrogen; muriate of potash 50½ per cent., high grade sulphate 49.2 per cent., and double manure salt 26.5 per cent. of actual potash.

WHOLESALE PRICES OF FERTILIZING MATERIALS.

	Cost of Nitrogen at wholesale in			Cost of Potash at wholesale in			
	Dried Blood.						
	Red. Cents per pound.	Nitrate of Soda. Cents per pound.	Sulphate of Ammonia. Cents per pound.	Muriate of Potash. Cents per pound.	Double Manure Salt. Cents per pound	High Grade Sulphate of Potash. Cents per pound.	Available Phosphoric Acid in Dissolved South Carolina Rock. Cents per pound.
Average of 6 months	**13.8**	**11.9**	**14.1**	**3.66**	**4.04**	**4.21**	**3.19**
September	13.6	11.4	13.4	3.66	4.04	4.21	3.30
October	14.0	11.5	13.4	3.66	4.04	4.21	3.30
November	14.4	11.6	13.4	3.66	4.04	4.21	3.26
December	14.2	11.6	13.5	3.66	4.04	4.21	3.12
1901. January	14.0	11.7	13.4	3.66	4.04	4.21	3.12
February	14.3	11.7	13.4	3.66	4.04	4.21	3.12
Average of 6 months	**14.1**	**11.6**	**13.4**	**3.66**	**4.04**	**4.21**	**3.20**
March	14.5	11.6	13.3	3.66	4.27	4.32	3.12
April	14.3	11.7	12.9	3.66	4.27	4.32	3.12
May	14.2	11.9	13.3	3.66	4.27	4.32	3.12
June	14.0	12.1	13.1	3.66	4.27	4.32	3.12
July	13.9	12.2	13.1	3.66	4.27	4.32	3.12
August	13.7	12.4	13.1	3.66	4.27	4.32	3.12
Average of 6 months	**14.1**	**11.9**	**13.1**	**3.66**	**4.27**	**4.32**	**3.12**
September	13.5	12.3	13.4	3.66	4.27	4.32	3.12
October	14.0	12.2	13.5	3.66	4.27	4.32	3.12
November	13.7	12.2	13.6	3.66	4.27	4.32	3.12
December	13.3	12.2	13.3	3.66	4.27	4.32	3.12
1902. January	13.6	12.7	13.6	3.66	4.27	4.32	3.12
February	13.5	14.2	14.1	3.66	4.27	4.32	3.12
Average of 6 months	**13.6**	**12.6**	**13.6**	**3.66**	**4.27**	**4.32**	**3.12**
March	14.0	14.9	14.1	3.66	4.27	4.32	3.12
April	14.5	15.5	14.5	3.66	4.27	4.32	3.12
May	14.9	17.1	14.8	3.66	4.27	4.32	3.12
June	14.5	13.6	15.0	3.66	4.22	4.30	3.12
July	14.2	12.9	14.5	3.63	4.16	4.29	3.12
August	14.3	12.1	14.1	3.63	4.16	4.29	3.12
Average of 6 months	**14.6**	**14.3**	**14.5**	**3.65**	**4.22**	**4.31**	**3.12**
September	14.6	12.0	14.5	3.63	4.16	4.29	3.12
October	15.2	12.1	14.3	3.63	4.16	4.29	3.12
November	14.8	12.5	14.2	3.63	4.16	4.29	3.12
December	14.9	13.6	14.5	3.63	4.16	4.29	3.12
1903. January	15.7	12.5	15.0	3.63	4.16	4.29	3.12
February	16.0	12.7	15.1	3.63	4.16	4.29	3.12
Average of 6 months	**15.2**	**12.6**	**14.6**	**3.63**	**4.16**	**4.29**	**3.12**
March	16.2	13.3	15.2	3.71	4.26	4.34	3.18
April	16.3	13.0	15.4	3.74	4.28	4.36	3.19
May	16.0	13.1	15.2	3.74	4.28	4.36	3.19
June	15.7	13.4	15.1	3.74	4.28	4.36	3.19
July	15.7	12.8	15.2	3.74	4.28	4.36	3.19
August	15.7	13.9	14.7	3.74	4.28	4.36	3.19
Average of 6 months	**15.9**	**13.3**	**15.1**	**3.73**	**4.28**	**4.36**	**3.19**
September	15.7	14.0	14.7	3.74	4.28	4.36	3.19
October	15.6	13.8	14.6	3.74	4.28	4.36	3.19

INDEX

Of the Fertilizer Analyses Included in this Report.

American Agricultural Chemical Co.:—
  Bradley's Complete Manure for Potatoes and Vegetables, 2, 74, 75
    " Superphosphate, 2, 58, 59
    " Potato Manure, 2, 76, 77
    " " Fertilizer, 2, 82, 83
    " Corn Phosphate, 2, 82, 83
    " Farmers' New Method Fertilizer, 2, 58, 59
    " Eclipse Phosphate, 2, 62, 63
    " Complete Manure for Top Dressing Grass and Grain, 2, 78, 79
    " Niagara Phosphate, 2, 62, 63
  Church's Fish and Potash, 2, 45, 60, 61
  Crocker's Potato, Hop and Tobacco Phosphate, 2, 80, 81
    " Ammoniated Corn Phosphate, 2, 80, 81
    " New Rival Fertilizer, 2, 58, 59
  Darling's Farm Favorite, 3, 58, 59
    " Potato Manure, 3, 80, 81
    " Dissolved Bone and Potash, 3, 44
    " Tobacco Grower, 3, 70, 71
    " Blood, Bone and Potash, 3, 50, 51
    " General Fertilizer, 3, 60, 61
  East India Complete Potato Manure, 3, 70, 71
    " A. A. Ammoniated Superphosphate, 3, 58, 59
  Great Eastern Northern Corn Special, 3, 78, 79
    " Vegetable, Vine and Tobacco, 3, 74, 75
    " General Fertilizer, 3, 58, 59
    " Grass and Oats Fertilizer, 3, 84, 85
    " Garden Special, 3, 52, 53
  Packer's Union Gardeners' Complete Manure, 3, 46, 50, 51
    " Animal Corn Fertilizer, 3, 80, 81
    " Potato Manure, 3, 72, 73
    " Universal Fertilizer, 3, 45, 62, 63
    " Wheat, Oats and Clover Fertilizer, 3, 82, 83
  Quinnipiac Market Garden Manure, 3, 54, 55
    " Phosphate, 3, 58, 59
    " Potato Manure, 3, 76, 77
    " " Phosphate, 3, 80, 81
    " Corn Manure, 3, 80, 81
    " Climax, 3, 60, 61
  Read's Practical Potato Special, 3, 84, 85
    " Standard Superphosphate, 3, 62, 63

American Agricultural Chemical Co., *continued*:—
  Read's Vegetable and Vine Fertilizer, ... 3, 76, 77
  Wheeler's Corn Fertilizer, ... 3, 84, 85
    " Potato Manure, ... 3, 78, 79
    " Havana Tobacco Grower, ... 3, 74, 75
    " Superior Truck Fertilizer, ... 3, 50, 51
    " Bermuda Onion Grower, ... 3, 80, 81
    " Grass and Oats Fertilizer, ... 3, 84, 85
  Williams & Clark's High Grade Special, . . . 3, 52, 53
    " " Americus Ammoniated Bone Superphosphate, ... 3, 58, 59
    " " Potato Phosphate, ... 3, 78, 79
    " " Americus Potato Manure, . . 3, 76, 77
    " " " Corn Phosphate, . . 3, 82, 83
  The A. A. C. Co.'s H. G. Tobacco Manure, . . 3, 64, 65, 68, 69, 70, 71, 84, 85
    " " Complete Tobacco Manure, . 3, 68, 69
    " " Southport XX Special, . . 3, 50, 51
  Complete Manure, with 10% Potash, ... 3, 52, 53
  Grass and Lawn Top Dressing, ... 3, 82, 83
  Castor Pomace, ... 3, 27
  Tobacco Starter and Grower, ... 3, 72, 73
  Dry Ground Fish, ... 3, 37, 39
  Fine Ground Bone, ... 3, 38, 39
  Nitrate of Soda, ... 3, 19
  Muriate of Potash, ... 3, 34, 35
  Tankage, ... 40, 41
American Farmers' Fertilizer Co.:—
  American Farmers' Market Garden Special. . . 4, 45, 54, 55
    " " Complete Potato, . . . 4, 65, 76, 77
    " " Corn King, ... 4, 65, 76, 77
    " " Ammoniated Bone, . . . 4, 52, 53
    " " Grain Grower, ... 4, 80, 81
Armour Fertilizer Works, The:—
  Grain Grower, ... 4, 78, 79
  Bone, Blood and Potash, ... 4, 43, 50, 51
  High Grade Potato, ... 4, 72, 73
  All Soluble, ... 4, 56, 57
  Ammoniated Bone with Potash, ... 4, 44
  Bone Meal, ... 4, 38, 39
Berkshire Fertilizer Co.:—
  Berkshire Complete Fertilizer, . . 4, 45, 46, 50, 51, 52, 53
    " Potato and Vegetable Phosphate, . . 4, 82, 83
    " Ammoniated Bone Phosphate, . . 4, 45, 62, 63
    " Fine Ground Bone, ... 4, 38, 39
Boardman, F. E.:—
  Boardman's Complete Fertilizer for Potatoes and General Crops, ... 4, 64, 68, 69

- Bohl, Valentine :—
  - Self-Recommending Fertilizer, 4, 38, 39
- Bowker Fertilizer Co.:—
  - Stockbridge Special Corn Manure, 4, 65, 78, 79
  - " Potato and Vegetable Manure, 4, 65, 70, 71
  - " Grass Top Dressing, 4, 64, 72, 73
  - Potato and Vegetable Fertilizer, 4, 74, 75, 84, 85
  - " " Phosphate, 4, 84, 85
  - Hill and Drill Phosphate, 4, 58, 59
  - Farm and Garden Phosphate, or Ammoniated Bone, 4, 60, 61
  - Fisherman's Brand Fish and Potash, 4, 54, 55
  - Tobacco Starter, 4, 78, 79
  - " Ash Elements, 4, 86, 87, 88
  - Complete Alkaline Tobacco Grower, 4, 86, 87, 88
  - Sure Crop Phosphate, 4, 62, 63
  - Market Garden Fertilizer, 4, 56, 57
  - Corn Phosphate, 4, 84, 85
  - Early Potato Manure, 4, 74, 75
  - Fine Ground Dry Fish, 4, 40
  - Fairfield Onion Fertilizer, 4, 72, 73
  - 25% Ash Compound, 4, 91, 92
  - Nitrate of Soda, 4, 19
  - Muriate of Potash, 4, 34, 35
  - Fresh Ground Bone, 4, 38, 39
  - Canada Hard Wood Ashes, 4, 96, 97
  - Acid Phosphate, 4, 28, 29
  - Square Brand Bone and Potash, 4, 44
  - Castor Pomace, 4, 27
  - Gloucester Fish and Potash, 4, 60, 61
  - Middlesex Special, 4, 45, 56, 57
  - Special Formula, 50, 51
  - Peruvian Guano, 62, 63
- Coe, E. Frank, Co.:—
  - E. Frank Coe's Ground Bone, 4, 38, 39
  - " H. G. Ammoniated Bone Superphosphate, 4, 60, 61
  - " Fish and Potash (FP), 4, 50, 51
  - " Gold Brand Excelsior Guano, 4, 50, 51
  - " Red Brand Excelsior Guano, 5, 45, 50, 51
  - " Long Islander Market Garden Special, 5, 45, 56, 57
  - " Columbian Corn, 5, 82, 83
  - " " Potato, 5, 78, 79
  - " Special Potato Manure, 5, 65, 82, 83
  - " Tankage, 40, 41
- Connecticut Fat Rendering and Fertilizer Corporation :—
  - Tankage, 40, 41
- Connecticut Valley Orchard Co., The :—
  - C. V. O. Co.'s Complete High Grade Fertilizer, 5, 43, 50, 51
- Cooper's Glue Factory, Peter :—
  - Pure Bone-Dust, 5, 38, 39

Dennis, E. C.:—
  Ground Bone, ... 5, 38, 39
Downs & Griffin :—
  Ground Bone, ... 5, 38, 39
Ellsworth, F.:—
  Shoemaker's Swift-Sure Superphosphate for General Use, 5, 52, 53, 62, 63
    " " Bone Meal, ... 5, 38, 39
    " " Superphosphate for Potatoes, 5, 64, 72, 73
Frisbie, L. T. Co., The :—
  Bone Meal, ... 5, 38, 39
Hemingway, L. H.:—
  Tankage, ... 40, 41
James, Ernest L., James' Bone Phosphate, ... 5, 62, 63
  " " Ground Bone, ... 5, 38, 39
Joynt, John, Canada Hard Wood Ashes, ... 5, 96, 97
Kelsey, E. R., Bone, Fish and Potash, ... 5, 50, 51
Lister's Agricultural Chemical Works :—
  Lister's Potato Manure, ... 5
    " Pure Raw Bone Meal, ... 5, 38, 39
    " Special 10% Potato, ... 5, 65, 74, 75
    " Success Fertilizer, ... 5, 56, 57
    " Standard Superphosphate of Lime, . . 5, 52, 53
    " Special Corn and Potato, ... 5, 65, 82, 83
    " Animal Bone and Potash, ... 5, 44
Lowell Fertilizer Co., *See Swift's Lowell Fertilizer Co.*
Ludlam, Frederick, "Cecrops" or Dragon's Tooth, . 5, 45, 52, 53
  " Cereal Brand of Cecrops Fertilizer, . 5, 58, 59
MacCormack, Wm., Mad River Strictly Pure Ground Bone, 5, 38, 39
Manchester, E. & Sons, Manchester's Formula, . . . 5, 50, 51
Mapes F. & P. G. Co., The :—
  Potato Manure,. 5, 74, 75
  Tobacco Starter, Improved, ... 5, 86, 87, 88
  Tobacco Manure, Wrapper Brand, ... 5, 66, 70, 71
  Fruit and Vine Manure, ... 5, 80, 81
  Economical Potato Manure, ... 5, 70, 71
  Vegetable Manure, or Complete Manure for Light Soils, 5, 52, 53
  Average Soil Complete Manure, ... 6, 45, 54, 55
  Corn Manure, ... 6, 76, 77
  Top Dresser, Improved, Half Strength, . . 6, 45, 60, 61
  Complete Manure ("A" Brand), ... 6, 45, 58, 59
  Dissolved Bone, ... 6, 52, 53
  Cereal Brand, ... 6, 60, 61
  Seeding Down Manure, ... 6, 70, 71
  Tobacco Ash Constituents, ... 6, 86, 87, 88
  Improved Top Dresser, Full Strength, . 6, 45, 46, 54, 55
Nassau Fertilizer Co., Gladiator Truck and Potato, . 6, 68, 69
  " Nassau Practical, ... 6, 50, 51

- National Fertilizer Co.:—
  - Chittenden's Market Garden Manure, ... 6, 56, 57
  - " Complete, ... 6, 45, 54, 55
  - " Potato Phosphate, . . . 6, 78, 79
  - " Ammoniated Bone, . . . 6, 60, 61
  - " Fine Ground Bone, . . . 6, 38, 39
  - " Universal Phosphate, . . . 6, 62, 63
  - " Fish and Potash, ... 6, 54, 55
  - " H. G. Special Tobacco Manure, . . 6, 64, 68, 69
  - " Complete Tobacco Fertilizer, . 6, 70, 71, 84, 85
- Ohio Farmers' Fertilizer Co., The :—
  - General Crop Fish Guano, ... 6, 62, 63
  - Ammoniated Bone and Potash, ... 6, 44
  - Potato and Tobacco Special, ... 6, 76, 77
- Olds & Whipple, Complete Tobacco Fertilizer, . 6, 86, 87, 88, 89
  - " Vegetable Potash, ... 6, 92
  - " Special Phosphate, ... 6, 56, 57
  - " Potato Fertilizer, ... 6, 72, 73
- Plumb & Winton, Ground Bone, ... 38, 39
- Rogers & Hubbard Co., The :—
  - Hubbard's Fertilizer for Oats and Top Dressing, , 6, 64, 68, 69
  - " '02 Top-Dress Phosphate, . . 6, 74, 75
  - " Grass and Grain Fertilizer, . . 6, 70, 71
  - " Soluble Corn Manure, . . . 6, 76, 77
  - " Soluble Potato Manure, . . . 6, 64, 70, 71
  - " Soluble Tobacco Manure, . . . 6, 68, 69
  - " All Soils and All Crops Phosphate, . 6, 56, 57
  - " Corn Phosphate, ... 6, 78, 79
  - " Potato Phosphate, ... 6, 65, 74, 75
  - " Raw Knuckle Bone Flour, . . 6, 38, 39
  - " Strictly Pure Fine Bone, . . . 6, 38, 39
- Rogers Manufacturing Co., The :—
  - All Round Fertilizer, ... 6, 60, 61
  - Complete Potato and Vegetable, . . . 6, 76, 77
  - Complete Corn and Onion, . . 6, 65, 67, 72, 73, 84, 85
  - Fish and Potash, ... 6, 56, 57
  - Soluble Tobacco and Potato, ... 6, 70, 71
  - Oat and Top Dressing, ... 6, 64, 68, 69
  - Grass and Grain for Seeding Down, . . . 6, 68, 69
  - Soluble Tobacco Fertilizer, ... 6, 68, 69
  - Pure Ground Bone, ... 6, 38, 39
  - Tobacco Starter, ... 65, 67, 80, 81, 84, 85
  - 25% Potash from Vegetable Sources, ... 92
- Russia Cement Co. :—
  - Essex XXX Fish and Potash, ... 6, 45, 56, 57
  - " Corn Fertilizer, ... 6, 82, 83
  - " Market Garden and Potato Manure, . . 7, 78, 79
  - " A1 Superphosphate, ... 7, 45, 60, 61

Russia Cement Co., *continued*:—
  Essex Complete Manure for Corn, Grain and Grass, 7, 72, 73
    " Complete Manure for Potatoes, Roots and Vegetables, 7, 68, 69
    " Tobacco Starter, 7, 74, 75
    " Special Tobacco Manure, 7, 64, 65, 68, 69, 70, 71
    " Odorless Lawn Dressing, 7, 45, 54, 55
    " Dry Ground Fish, 7, 37, 42
    " Fine Bone Meal, 7, 38, 39
Sanderson Fertilizer and Chemical Co.:—
  Sanderson's Formula A, 7, 54, 55, 62, 63
    " Formula B for Tobacco, 7, 64, 72, 73
    " Corn Superphosphate, 7, 65, 84, 85
    " Potato Manure, 7, 65, 82, 83
    " Blood, Bone and Meat, 7, 40, 41
    " Fine Ground Bone, 7, 38, 39
    " Special with 10% Potash, 7, 45, 58, 59
    " Plain Superphosphate, 7, 28, 29
  Luce Bros.' Bone, Fish and Potash, 7, 58, 59
  Nitrate of Soda, 7, 19
  Muriate of Potash, 7, 34, 35
  Double Sulphate of Potash, 7, 34, 35
Shay, C. M., Mystic Gilt Edge Potato Manure, 7, 64, 68, 69
  " Pure Ground Bone, 7, 38, 39
  " Corn Manure, 7, 74, 75
Shoemaker, M. L. & Co., *See Ellsworth, F.*
Swift's Lowell Fertilizer Co.:—
  Swift's Lowell Potato Phosphate, 7, 72, 73
    " Potato Manure, 7, 80, 81
    " Bone Fertilizer, 7, 60, 61
    " Animal Brand, 7, 56, 57
    " Dissolved Bone and Potash, 7, 44
    " Ground Bone, 7, 38, 39
    " Market Garden Manure, 7, 56, 57
    " Perfect Tobacco Grower, 7, 74, 75
    " Tankage, 40, 41
Wilcox Fertilizer Works:—
  Wilcox's Potato, Onion, and Tobacco Manure, 7, 70, 71
    " Potato Manure, 7, 72, 73
    " Complete Bone Superphosphate, 7, 54, 55
    " Special Superphosphate, 7, 56, 57
    " High Grade Fish and Potash, 7, 52, 53
    " Fish and Potash, 7, 52, 53
    " Grass Fertilizer, 7, 72, 73
    " Dry Ground Fish, 7, 40
    " Pure Ground Bone, 7, 38, 39
    " Nitrate of Soda, 7, 19
    " Acid Phosphate, 7, 28, 29
    " Muriate of Potash, 7, 34, 35
Woodruff, S. D. & Sons, Home Mixed Fertilizer, 7, 90, 91

EIGHTH

REPORT ON FOOD PRODUCTS.

To His Excellency, Abiram Chamberlain, Governor of Connecticut:

As required by law, I herewith submit to you the Eighth Report of the Connecticut Agricultural Experiment Station on Food Products, for the year ending July 31, 1903.

This report gives the results of a large number of analyses of food products bought by the Station in different parts of the state, or sent to us for test by the Dairy Commissioner and other individuals. The report also contains a number of microscopic studies made by Mr. A. L. Winton which are not immediately connected, in all cases, with any particular sample now under examination.

The work described in these studies was necessary in order to put us in position to certainly detect some materials found as impurities or adulterations in food products and commercial feeding stuffs; materials whose chemical and microscopic characters have not hitherto been adequately described.

Mr. Winton, having gone through this work with great care in our own interest, has recorded and explained the results as a contribution to our knowledge and a help to all others who have similar work to do.

I believe that this is the first agricultural station in this country to which has been committed by state law the work of examining food products. Each year there has been made in its report some contribution of permanent scientific value to our knowledge of the methods of examination of these products.

Interest in the subject of pure food is rapidly increasing and one state after another is enacting laws modeled after those of Massachusetts and Connecticut. It has been our lot, besides making the tests of food products required by the letter of the law, to do some work of a pioneer nature, for the general good.

Very respectfully,

E. H. JENKINS, *Director.*

LAW REGULATING THE MANUFACTURE AND SALE OF FOOD PRODUCTS.

There are on the Statute book nine distinct laws regarding the manufacture and sale of adulterated food products. Only one, however, imposes duties on this Station. This is found in Sections 2573 to 2578, inclusive, of the General Statutes of Connecticut, revision of 1902.

Copies of the law will be sent on application to this Station.

The law defines the word food so as to include everything used as food or drink by men, horses or cattle. It also strictly defines the terms misbranded and adulterated, and imposes a penalty of not more than five hundred dollars, or imprisonment for not more than one year, for adulterating food products, or for knowingly selling adulterated food products as unadulterated, or without informing the purchaser that they are adulterated.

The Dairy Commissioner is charged with the enforcement of the law.

This Station is required to make analyses of food products on sale in this state, or kept in this state for export, to report to the Dairy Commissioner whenever it finds adulterated goods sold within the state, that prosecution may be brought, and to make an annual report to the Governor upon adulterated food products.

FOOD DEFINITIONS AND STANDARDS.

The Secretary of Agriculture of the United States, acting under authority conferred by act of Congress, approved June 3, 1902, has recently proclaimed and established certain standards of purity for food products with their definitions, as the official standards of these food products for the United States of America.

They will therefore be authoritative in all the federal courts. These standards and definitions were prepared by a committee of the Association of Official Agricultural Chemists with the assistance of other members of the Association and of chemists and others outside of the Association.

The chemical data for these standards were obtained partly from a review of all published literature on the subject and partly from investigations made by the persons named below who assisted in the work. All the food standards adopted by European countries were consulted and every provisional schedule was submitted to the manufacturing firms and to the trade interested, for criticisms, and when requested by them conferences for discussion were arranged. It would seem that all available skill and care had been used to make these definitions and standards as nearly perfect as possible.

Two members of the staff of this Station have been actively engaged in work connected with the establishment of these federal standards: Mr. Winton has contributed elaborate chemical and microscopic investigations of the different kinds of spices and of different grades of the same kind, and also a valuable study of the various grades of the cocoa bean and its commercial products; investigations which have been printed in previous reports of the Station and have been copied in scientific journals in this country and abroad.

Mr. Jenkins has served as one of the Committee appointed by the Association of Official Agricultural Chemists, and charged by the Secretary of Agriculture with the preparation of these definitions and standards.

Section 2575 of the General Statutes of Connecticut provides that this Experiment Station "may fix standards of purity, quality or strength, when such standards are not specified by law."

It is extremely desirable for all concerned that the food laws of the several states should be substantially alike and especially that all should have the same standards of purity, quality and strength. The Station has, therefore, up to the present, fixed no standards of any kind, awaiting the action of the Secretary of Agriculture, whose decisions rest on a wider foundation of experience and study than this Station alone could have provided.

The Station now adopts and fixes, so far as its authority extends, those standards of purity, quality and strength, with the related definitions, which have been already adopted by the Secretary of Agriculture of the United States and which are given here together with the report of the consulting Committee to the Secretary.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF CHEMISTRY,
WASHINGTON, D. C.

To the Honorable The Secretary of Agriculture of the United States.

SIR: The undersigned, representing The Association of Official Agricultural Chemists of the United States, and commissioned by you, under authority given by the Act of Congress, approved March 3, 1903, to collaborate with you "to establish standards of purity for food products and to determine what are regarded as adulterations therein, for the guidance of the officials of the various States and of the Courts of Justice," respectfully submit herewith, for your consideration, standards for certain articles belonging to the schedules of meat and the principal meat products, milk and its products, sugars and related substances, and condiments and cocoa and cocoa products, with the recommendation that they be approved and proclaimed the established standards.

In connection therewith are presented a classified list of the various schedules of food products for which standards are being prepared and a statement of some of the more important general principles upon which the standards are based.

Before the adoption of any schedule it was submitted to the manufacturing firms and the trade immediately interested for criticisms, and, when requested by them, conferences for discussion have been arranged. Certain questions have arisen in the discussion of these standards relative to several substances sometimes used as preservatives or coloring matters. In the judgment of the committee these questions can most satisfactorily be treated in connection with Schedule III, Preservatives and Coloring Matters, and recommendations have therefore been deferred pending the consideration of that schedule.

For the primary definitions and standards and for the compilations of data for standards and constant assistance in the revision of the schedules the committee is greatly indebted to the following persons: Charles D. Woods, Ph.D., director of the Maine Agricultural Experiment Station, Orono, Me., referee on meat and its products; L. L. Van Slyke, Ph.D., chemist of the New York Agricultural Experiment Station, Geneva, N. Y., referee on milk and its products; Charles A. Crampton, M.D., chemist of the Bureau of Internal Revenue, referee on beverages, including cocoa and cocoa products; A. L. Winton, Ph.B., chemist of the Connecticut Agricultural Experiment Station, New Haven, Conn., referee on condiments.

The committee is also indebted to others for information and helpful suggestions, which will be more specifically acknowledged in a report of its work to be later submitted.

Very respectfully,
WILLIAM FREAR,
EDWARD H. JENKINS,
MELVILL A. SCOVELL,
HENRY A. WEBER,
HARVEY W. WILEY.

PRINCIPLES ON WHICH THE DEFINITIONS AND STANDARDS ARE BASED.

The general considerations which have guided the committee in preparing the definitions and standards for food products are the following:

1. The main classes of food articles are defined before the subordinate classes are considered.
2. The names of the various substances for which standards are proposed are defined.
3. The definitions are so framed as to exclude from the articles defined substances not included in the definitions.
4. The definitions include, where possible, those qualities which make the articles described wholesome for human food.
5. A term defined in any of the several schedules has the same meaning wherever else it is used in this report.
6. The names of food products herein defined usually agree with existing American trade or manufacturing usage, but where such usage is not clearly established or where trade names confuse two or more articles for which specific designations are desirable, preference is given to one of the several trade names applied.
7. Standards are based upon data representing materials produced under American conditions and manufactured by American processes or representing such varieties of foreign articles as are chiefly imported for American use.
8. The standards fixed are such that a departure of the articles to which they apply, above the maximum or below the minimum limit prescribed, is evidence that such articles are of inferior or abnormal quality.
9. The limits fixed as standard are not necessarily the extremes authentically recorded for the article in question, because such extremes are commonly due to abnormal conditions of production and are usually accompanied by marks of inferiority or abnormality readily perceived by the producer or manufacturer.

FOOD DEFINITIONS AND STANDARDS.

I. ANIMAL PRODUCTS.

A. MEATS AND THE PRINCIPAL MEAT PRODUCTS.

a. MEATS.

Definitions.

1. *Meat* is any sound, dressed, and properly prepared edible part of animals in good health at the time of slaughter. The term "animals," as herein used, includes not only mammals, but fish, fowl, crustaceans, mollusks, and all other animals used as food.
2. *Fresh meat* is meat from animals recently slaughtered or preserved only by refrigeration.
3. *Salted, pickled,* and *smoked meats* are unmixed meats preserved by salt, sugar, vinegar, spices, or smoke, singly or in combination, whether in bulk or in packages.

Standard.

Standard meat, fresh meat, and salted, pickled, and smoked meats are such as conform respectively to the foregoing definitions.

b. MANUFACTURED MEATS.

Definition.

1. *Manufactured meats* are meats not included in definitions 2 and 3, whether simple or mixed, whole or comminuted, in bulk or packages, with or without the addition of salt, sugar, vinegar, spices, smoke, oils, or rendered fat.

Standard.

Standard manufactured meats conform to the foregoing definition. If they bear names descriptive of composition they correspond thereto, and when bearing such descriptive names, if force or flavoring meats are used, the kind and quantity thereof are made known.

c. MEAT EXTRACTS, MEAT PEPTONES, ETC.

(Schedule in preparation.)

d. LARD.

Definitions.

1. *Lard* is the rendered fresh fat from slaughtered, healthy hogs.

2. *Leaf lard* is the lard rendered at moderately high temperatures from the internal fat of the abdomen of the hog, excluding that adherent to the intestines.

Standard.

Standard lard and *standard leaf lard* are lard and leaf lard, respectively, free from rancidity, containing not more than one (1) per cent. of substances other than fatty acids, not fat, necessarily incorporated therewith in the process of rendering, and standard leaf lard has an iodine number not greater than sixty (60).

Definition.

3. *Neutral lard* is lard rendered at low temperatures.

B. MILK AND ITS PRODUCTS.

a. MILKS.

Definition.

1. *Milk (whole milk)* is the lacteal secretion obtained by the complete milking of one or more healthy cows, properly fed and kept, excluding that obtained within fifteen days before and five days after calving.

Standard.

Standard milk is milk containing not less than twelve (12) per cent. of total solids and not less than eight and one-half (8.5) per cent. of solids not fat, nor less than three and one-quarter (3.25) per cent. of milk fat.

Definitions.

2. *Blended milk* is milk modified in its composition so as to have a definite and stated percentage of one or more of its constituents.

3. *Skim milk* is milk from which a part or all of the cream has been removed.

Standard.

Standard skim milk is skim milk containing not less than nine and one-quarter (9.25) per cent. of milk solids.

4. *Buttermilk* is the product that remains when butter is removed from milk or cream in the process of churning.

5. *Pasteurized milk* is standard milk that has been heated below boiling but sufficiently to kill most of the active organisms present and immediately cooled to fifty degrees (50°) Fahr. or lower to retard the development of their spores.

6. *Sterilized milk* is standard milk that has been heated at the temperature of boiling water or higher for a length of time sufficient to kill all organisms present.

7. *Condensed milk* is milk from which a considerable portion of water has been evaporated.

8. *Sweetened condensed milk* is milk from which a considerable portion of water has been evaporated and to which sugar (sucrose) has been added.

Standard.

Standard condensed milk and *standard sweetened condensed milk* are condensed milk and sweetened condensed milk, respectively, containing not less than twenty-eight (28) per cent. of milk solids, of which not less than one-fourth is milk fat.

9. *Condensed skim milk* is skim milk from which a considerable portion of water has been evaporated.

b. MILK FAT OR BUTTER FAT.

Definition.

1. *Milk fat or butter fat* is the fat of milk.

Standard.

Standard milk fat or butter fat has a Reichert-Meissl number not less than twenty-four (24) and a specific gravity not less than 0.905 (40° C. /40° C.).

C. CREAM.

Definition.

1. *Cream* is that portion of milk, rich in butter fat, which rises to the surface of milk on standing, or is separated from it by centrifugal force.

Standard.

Standard cream is cream containing not less than eighteen (18) per cent. of milk fat.

2. *Evaporated cream* is cream from which a considerable portion of water has been evaporated.

d. BUTTER.

Definition.

1. *Butter* is the product obtained by gathering in any manner the fat of fresh or ripened milk or cream into a mass, which also contains a small portion of the other milk constituents, with or without salt. By acts of Congress approved August 2d, 1886, and May 9th, 1902, butter may also contain additional coloring matter.

Standard.

Standard butter is butter containing not less than eighty-two and five-tenths (82.5) per cent. of butter fat.

Definition.

2. *Renovated or process butter* is the product obtained by melting butter and reworking, without the addition or use of chemicals or any substances except milk, cream, or salt.

Standard.

Standard renovated or process butter is renovated or process butter containing not more than sixteen (16) per cent. of water and at least eighty-two and five-tenths (82.5) per cent. of butter fat.

e. CHEESE.

Definitions.

1. *Cheese* is the solid and ripened product obtained by coagulating the casein of milk by means of rennet or acids, with or without the addition of ripening ferments and seasoning. By act of Congress, approved June 6, 1896, cheese may also contain additional coloring matter.

2. *Whole milk or full cream cheese* is cheese made from milk from which no portion of the fat has been removed.

3. *Skim-milk cheese* is cheese made from milk from which any portion of the fat has been removed.

4. *Cream cheese* is cheese made from milk and cream, or milk containing not less than six (6) per cent. of fat.

Standard.

Standard whole-milk cheese or full-cream cheese is whole-milk or full-cream cheese containing in the water-free substance not less than fifty (50) per cent. of butter fat.

f. MISCELLANEOUS MILK PRODUCTS.

Definition.

1. *Ice cream* (In preparation).

Standard.

Standard ice cream (In preparation).

Definitions.

Whey is the product remaining after the removal of fat and casein from milk in the process of cheese making.

3. *Kumiss* is mare's or cow's milk, with or without the addition of sugar (sucrose), which has undergone alcoholic fermentation.

II. VEGETABLE PRODUCTS.

A. Grain Products.

(Schedule in preparation.)

B. Fruits and Vegetables.

(Schedule in preparation.)

C. Sugars and Related Substances.

a. SUGAR AND SUGAR PRODUCTS.

Definition.

1. *Sugar* is the product chemically known as sucrose (saccharose), chiefly obtained from sugar cane, sugar beets, sorghum, maple, or palm.

Standard.

Standard sugar is white sugar containing at least ninety-nine and five-tenths (99.5) per cent. of sucrose.

Definitions.

2. *Granulated, loaf, cut, milled, and powdered sugars* are different forms of standard sugars.
3. *Maple sugar* is the solid product resulting from the evaporation of maple sap.
4. *Massecuite, melada, mush sugar,* and *concrete* are products obtained by evaporating the purified juice of a sugar-producing plant, or a solution of sugar, to a solid or semi-solid consistence in which the sugar chiefly exists in a crystalline state.
5. *Molasses* is the product left after separating the sugar from massecuite, melada, mush sugar, or concrete.

Standard.

Standard molasses is molasses containing not more than twenty-five (25) per cent. of water nor more than five (5) per cent. of ash.

Definitions.

6. *Sirup* is the product obtained by purifying and evaporating the juice of a sugar-producing plant without removing any of the sugar.
7. *Sugar-cane sirup* is a sirup obtained by the evaporation of the juice of the sugar cane or by the solution of sugar-cane concrete.
8. *Sorghum sirup* is a sirup obtained by the evaporation of sorghum juice or by the solution of sorghum concrete.
9. *Maple sirup* is a sirup obtained by the evaporation of maple sap or by the solution of maple concrete.
10. *Sugar sirup* is a product obtained by dissolving sugar to the consistence of a sirup.

Standard.

Standard sirup is a sirup containing not more than thirty (30) per cent. of water nor more than two and five-tenths (2.5) per cent. of ash.

b. GLUCOSE PRODUCTS.

Definition.

1. *Starch sugar or grape sugar* is the solid product obtained by hydrolyzing starch or a starch-containing substance until the greater part of the starch is converted into dextrose. Starch sugar or grape sugar appears in commerce in two forms, anhydrous and hydrous. In the former, the sugar is crystallized without water of crystallization; in the latter, it is crystallized with water of crystallization. The hydrous varieties are commonly known as 70 and 80 sugars; 70 sugar is also known as brewers' sugar, and 80 sugar as climax or acme sugar.

Standards.

(a) *Standard 70 sugar or brewers' sugar* is hydrous starch sugar containing not less than seventy (70) per cent. of dextrose and not more than eight-tenths (0.8) per cent. of ash.

(b) *Standard 80 sugar, climax or acme sugar,* is hydrous starch sugar containing not less than eighty (80) per cent. of dextrose and not more than one and one-half (1.5) per cent. of ash.

(c) *Standard anhydrous grape sugar* is anhydrous grape sugar containing not less than ninety-five (95) per cent. of dextrose without water of crystallization and not more than eight-tenths (0.8) per cent. of ash.

The ash of these standard products consists almost entirely of chlorides and sulphates of lime and soda.

Definition.

2. *Glucose, mixing glucose, or confectioners' glucose,* is a thick sirupy substance obtained by incompletely hydrolyzing starch or a starch-containing substance, decolorizing and evaporating the product. It is found in various degrees of concentration, ranging from forty-one (41) to forty-five (45) degrees Baumé.

Standard.

Standard glucose, mixing glucose, or confectioners' glucose, is colorless glucose, varying in density between forty-one (41) and forty-five (45) degrees Baumé, at a temperature of one hundred (100) degrees F. (37.7° C.). It conforms in density, within these limits, to the degree Baumé it is claimed to show, and for a density of forty-one (41) degrees Baumé contains not more than twenty-one (21) per cent. of water and for a density of forty-five (45) degrees not more than fourteen (14) per cent. It contains on a basis of forty-one (41) degrees Baumé not more than one (1) per cent. of ash, consisting chiefly of chlorids and sulphates of lime and soda.

Definition.

3. *Glucose sirup or corn sirup* is glucose unmixed or mixed with sirup or molasses.

Standard.

Standard glucose sirup or corn sirup is glucose sirup or corn sirup containing not more than twenty-five (25) per cent. of water nor more than three (3) per cent. of ash.

c. CANDY.

Definition.

1. *Candy* is a product prepared from a saccharine substance or substances, with or without the addition of harmless coloring, flavoring, or filling materials.

Standard.

2. *Standard candy* is candy containing no terra alba, barytes, talc, chrome yellow, or other mineral substances or poisonous colors or flavors or other ingredients injurious to health.

d. HONEY.

(Schedule in preparation.)

D. CONDIMENTS (EXCEPT VINEGAR).

a. SPICES.

General Definition.

1. *Spices* are aromatic vegetable substances used for the seasoning of food.

General Standard.

Standard spices are sound spices, true to name, from which no portion of any volatile oil or other flavoring principle has been removed.

Definition.

2. *Allspice or pimento* is the dried fruit of *Pimenta officinalis* Lindl.

Standard.

Standard allspice is allspice containing not less than eight (8) per cent. of quercitannic acid;* not more than six (6) per cent. of total ash; not more than five-tenths (0.5) per cent. of ash insoluble in hydrochloric acid, and not more than twenty-five (25) per cent. of crude fiber.

Definitions.

3. *Anise* is the fruit of *Pimpinella anisum* L.
4. *Bay leaf* is the dried leaves of *Laurus nobilis* L.
5. *Capers* are the flower buds of *Capparis spinosa* L.
6. *Caraway* is the fruit of *Carum carvi* L.

CAYENNE AND RED PEPPERS.

7. *Red pepper* is the red, dried, ripe fruit of any species of *Capsicum*.

8. *Cayenne pepper or cayenne* is the dried, ripe fruit of *Capsicum fastigiatum* DC., *Capsicum frutescens* L., *Capsicum baccatum* L., or some other small-fruited species of *Capsicum*.

Standard.

Standard cayenne pepper is cayenne pepper containing not less than fifteen (15) per cent. of non-volatile ether extract; not more than six and five-tenths (6.5) per cent. of total ash; not more than five-tenths (0.5) per cent. of ash insoluble in hydrochloric acid; not more than one and five-tenths (1.5) per cent. of starch by the diastase methods, and not more than twenty-eight (28) per cent. of crude fiber.

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* Calculated from the total oxygen absorbed by the aqueous extract.

Definitions.

9. *Celery seed* is the dried seed of *Apium graveolens* L.
10. *Cinnamon* is the dried bark of any species of the genus *Cinnamomum* from which the outer layers may or may not have been removed.
11. *True cinnamon* is the dried inner bark of *Cinnamomum zeylanicum* Breyne.
12. *Cassia* is the dried bark of various species of *Cinnamomum,* other than *Cinnamomum zeylanicum,* from which the outer layers may or may not have been removed.
13. *Cassia buds* are the dried immature fruit of species of *Cinnamomum.*
14. *Ground cinnamon or ground cassia* is a powder consisting of cinnamon, cassia or cassia buds, or a mixture of these spices.

Standard.

Standard cinnamon or cassia is cinnamon or cassia containing not more than eight (8) per cent. of total ash and not more than two (2) per cent. of sand.

Definition.

15. *Cloves* are the dried flower buds of *Eugenia caryophyllata,* Thunb. (*Caryophyllus aromaticus* L.) which contain not more than five (5) per cent. of clove stems.

Standard.

Standard cloves are cloves containing not less than ten (10) per cent. of volatile ether extract; not less than twelve (12) per cent. of quercitannic acid;* not more than eight (8) per cent. of total ash; not more than five-tenths (0.5) per cent. of ash insoluble in hydrochloric acid, and not more than ten (10) per cent. of crude fiber.

Definitions.

16. *Coriander* is the dried fruit of *Coriandrum sativum* L.
17. *Cumin seed* is the fruit of *Cuminum cyminum* L.
18. *Dill seed* is the fruit of *Peucedanum graveoleus* Benth. and Hook.
19. *Fennel* is the fruit of *Foeniculum vulgare* Gaertn.
20. *Ginger* is the washed and dried, or decorticated and dried, rhizome of *Zingiber officinale* Roscoe.

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* Calculated from the total oxygen absorbed by the aqueous extract.

*Standard.**

Standard ginger is ground or whole ginger containing not less than forty-two (42) per cent. of starch by the diastase method nor less than forty-six (46) per cent. of starch by direct inversion,† not more than eight (8) per cent. of crude fiber, not more than eight per cent. of total ash, not more than one (1) per cent. of lime, and not more than three (3) per cent. of ash insoluble in hydrochloric acid.

Definition.

21. *Limed or bleached ginger* is whole ginger coated with carbonate of lime.

Standard.

Standard limed or bleached ginger is limed or bleached ginger containing not more than ten (10) per cent. of ash, not more than four (4) per cent. of carbonate of lime, and conforming in other respects to standard ginger.

Definition.

22. *Horse-radish* is the root of *Cochlearia armoracia* L.

Standard.

Standard grated or ground horse-radish may be mixed with vinegar.

Definition.

23. *Mace* is the dried arillus of *Myristica fragrans* Houttuyn.

Standard.

Standard macc is mace containing not less than twenty (20) nor more than thirty (30) per cent. of non-volatile ether extract, not more than three (3) per cent. of total ash, not more than five-tenths (0.5) per cent. of ash insoluble in hydrochloric acid, and not more than ten (10) per cent. of crude fiber.

Definitions.

24. *Macassar or Papua mace* is the dried arillus of *Myristica argentea* Warb.

25. *Bombay mace* is the dried arillus of *Myristica malabarica* Lamarck.

26. *Marjoram* is the leaves, flowers, and branches of *Origanum Marjorana* L.

27. *Mustard seed* is the seed of *Sinapis alba* L. (white mustard), *Brassica nigra* Koch (black mustard), or *Brassica juncea* Coss. (black or brown mustard).

28. *Ground mustard* is a powder made from mustard seed, with or without the removal of the hulls and a portion of the fixed oil.

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* The standard here given differs from that of Circular No. 10 of the U. S. Department of Agriculture. The latter, we believe, contains typographical or other errors, and does not represent the standard adopted by the Committee, while the standard here given is what was adopted.

† Copper-reducing matters by direct inversion calculated as starch.

Standard.

Standard ground mustard is mustard containing not more than two and five-tenths (2.5) per cent. of starch by the diastase method and not more than eight (8) per cent. of total ash.

Definition.

29. *Nutmeg* is the dried seed of *Myristica fragrans* Houttuyn, deprived of its testa and with or without a thin coating of lime.

Standard.

Standard nutmegs, ground or unground, are nutmegs containing not less than twenty-five (25) per cent. of non-volatile ether extract; not more than five (5) per cent. of total ash; not more than five-tenths (0.5) per cent. of ash insoluble in hydrochloric acid, and not more than ten (10) per cent. of crude fiber.

Definitions.

30. *Macassar, Papua, male, or long nutmeg* is the dried seed of *Myristica argentea* Warb. deprived of its testa.

31. *Paprica* is the dried ripe fruit of *Capsicum annuum* L., *Capsicum longum* DC., or some other large-fruited species of *Capsicum.*

PEPPER.

32. *Black pepper* is the dried immature berries of *Piper nigrum* L.

Standard.

Standard black pepper is black pepper free from added pepper shells, pepper dust, and other pepper by-products and containing not less than six (6) per cent. of non-volatile ether extract; not less than twenty-two (22) per cent. of starch by the diastase method; not less than twenty-eight (28) per cent. of starch by direct inversion,* not more than seven (7) per cent. of total ash; not more than two (2) per cent. of ash insoluble in hydrochloric acid, and not more than fifteen (15) per cent. of crude fiber. One hundred parts of the non-volatile ether extract contain not less than three and one quarter (3.25) parts of nitrogen.

33. *Long pepper* is the dried fruit of *Piper longum* L.

34. *White pepper* is the dried mature berries of *Piper nigrum* L., from which the outer coating, or the outer and inner coatings, have been removed.

Standard.

Standard white pepper is white pepper containing not less than six (6) per cent. of non-volatile ether extract; not less than fifty-three (53) per cent. of starch by the diastase method; not less than forty (40) per cent. of starch by direct inversion;* not more than four (4) per cent. of total ash; not more than five-tenths (0.5) per cent. of ash insoluble in hydrochloric acid, and not more than five (5) per cent. of crude fiber. One hundred parts of the non-volatile ether extract contain not less than four (4) parts of nitrogen.

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* Copper reducing matters by direct inversion calculated as starch.

35. *Saffron* is the dried stigmas of *Crocus sativus* L.

36. *Sage* is the leaves of *Salvia officinalis* L.

37. *Savory, or summer savory* is the leaves, blossoms, and branches of *Satureia hortensis* L.

38. *Thyme* is the leaves and ends of blooming branches of *Thymus vulgaris* L.

b. FRUIT EXTRACTS.

(Schedule in preparation.)

c. SALAD OILS.

(Schedule in preparation.)

d. SALT.

(Schedule in preparation.)

E. BEVERAGES (AND VINEGAR).

a. TEA.

(Schedule in preparation.)

b. COFFEE.

(Schedule in preparation.)

c. COCOA AND COCOA PRODUCTS.

Definitions.

1. *Cocoa beans* are the seeds of the cacao tree, *Theobroma cacao* L.

2. *Cocoa nibs,* or *cracked cocoa,* is the roasted, broken cocoa bean freed from its shell or husk.

3. *Chocolate, plain or bitter, chocolate liquor,* is the solid or plastic mass obtained by grinding cocoa nibs without the removal of fat or other constituents except the germ.

Standard.

Standard chocolate is chocolate containing not more than three (3) per cent. of ash insoluble in water, three and fifty hundredths (3.50) per cent. of crude fiber and nine (9) per cent. of starch nor less than forty-five (45) per cent. of cocoa fat.

Definition.

4. *Sweet chocolate* and *chocolate coatings* are plain chocolate mixed with sugar (sucrose), with or without the addition of cocoa butter, spices, or other flavoring materials.

Standard.

Standard sweet chocolate and standard chocolate coatings are sweet chocolate and chocolate coatings containing in the sugar- and fat-free residue no higher percentage of either ash, fiber, or starch than is found in the sugar- and fat-free residue of plain chocolate.

Definition.

5. *Cocoa or powdered cocoa* is cocoa nibs, with or without the germ, deprived of a portion of its fat and finely pulverized.

Standard.

Standard cocoa is cocoa containing percentages of ash, crude fiber, and starch corresponding to those in chocolate after correction for fat removed.

Definition.

6. *Sweet or sweetened cocoa* is cocoa mixed with sugar (sucrose).

Standard.

Standard sweet cocoa is sweet cocoa containing not more than sixty (60) per cent. of sugar (sucrose) and in the sugar- and fat-free residue no higher percentage of either ash, crude fiber or starch than is found in the sugar- and fat-free residue of plain chocolate.

d. FRUIT JUICES—FRESH, SWEET, AND FERMENTED.

(In preparation.)

e. VINEGAR.

(In preparation.)

f. MEAD, ROOT BEER, ETC.

g. MALT LIQUORS.

(In preparation.)

h. SPIRITUOUS LIQUORS.

(In preparation.)

i. CARBONATED WATERS, ETC.

III. PRESERVATIVES AND COLORING MATTERS.

(In preparation.)

The formal adoption of the above standards is as follows:

UNITED STATES DEPARTMENT OF AGRICULTURE,

OFFICE OF THE SECRETARY.—CIRCULAR NO. 10.

STANDARDS OF PURITY FOR FOOD PRODUCTS.

WHEREAS, The Congress of the United States by an act approved June 3, 1902, authorized the Secretary of Agriculture to establish standards of purity for food products; and

WHEREAS, He was empowered by this act to consult with the Committee on Food Standards of the Association of Official Agricultural Chemists and other experts in determining these standards; and

WHEREAS, He has in accordance with the provisions of the act availed himself of the counsel and advice of these experts and of the trade interests touching the products for which standards have been determined and has reached certain conclusions based on the general principles of examination and conduct hereinafter mentioned;

Therefore, I, James Wilson, Secretary of Agriculture, do hereby proclaim and establish the following standards for purity of food products together with their precedent definitions as the official standards of these food products for the United States of America.

JAMES WILSON.

Washington, D. C., November 20, 1903.

SAMPLES EXAMINED BY THE STATION.

During the year covered by this report, the sampling agent has purchased in fifteen towns and villages, 227 samples of food products, the examinations of which are described on following pages; private individuals have sent for analysis 30 samples, and from the Dairy Commissioner have been received and examined 882 samples.

From 1886, when the office of Dairy Commissioner was established, to the present, this Station has done, at its own cost, all the chemical work desired by the Commissioner and has given all needed expert work in court.

In the following pages the results of the work of this year are presented by members of the Station staff.

CHOCOLATE AND OTHER PRODUCTS OF THE COCOA BEAN.

BY A. L. WINTON, E. MONROE BAILEY AND M. SILVERMAN.

Chocolate and cocoa are made from the "beans" or seeds of several small trees, natives of tropical America, of which *Theobroma cacao* L. is by far the most important. Cocoa beans were highly esteemed by the aborigines, especially the Aztecs of Mexico and Peru, who prepared from them beverages and foods. They were brought to the notice of Europeans by Cortez and other explorers, but were not extensively imported into Europe until the seventeenth century, about the time tea and coffee were introduced from the East. At present the world's supply comes chiefly from Venezuela, Guiana, Ecuador, Brazil, Trinidad, Cuba, Mexico, and other regions bordering on the Gulf of Mexico, being gathered in these regions from trees both wild and cultivated, and also to some extent from Java, Ceylon, Africa and other parts of the Old World, where the tree has been successfully cultivated.

The yellow or brown cocoa fruit is from 4 to 6 inches long, from 2 to 3 inches wide, and has 10 ridges passing from the base to the apex giving the surface a melon-like appearance. It contains from 35 to 75 seeds in five rows, embedded in a mucilaginous substance.

The seeds after being removed from the fruit and freed from the adhering pulp are dried at once in some localities, but the better grades are first subjected to a fermentation process, which destroys certain bitter and acrid constituents.

Cocoa beans as they come into the market are reddish brown in color, and somewhat resemble Lima beans in shape and size, but are not so strongly flattened nor are they kidney shaped. Like Lima beans they consist of two thickened cotyledons or seed leaves, connected with a small rootlet and enclosed within a hull or shell. The dark brown cotyledons are irregularly folded and readily break into angular pieces.

Process of Manufacture. The first stages in the manufacture of both chocolate and cocoa are the same.

After removing stones, chips and other impurities, the beans are roasted, thus developing a desirable flavor and facilitating the processes of separation from the shell and grinding. The beans are then crushed by machinery and separated from the shells. In some factories the "germs" (rootlets) are also removed.

The broken cotyledons, free of shells, known as "cocoa nibs," are next ground in the chocolate mill. The heat of grinding melts the fat which makes up about half the weight of the nibs, and the ground product runs out of the mill as a thin paste. This paste, after cooling in moulds, is chocolate, also known as plain or bitter chocolate to distinguish it from the sweetened product. In the factory it is often known as chocolate liquor. Sweet chocolate is prepared by mixing pulverized sugar, vanilla, or other flavor, and usually cocoa butter with the warm chocolate paste before moulding.

Cocoa is prepared by removing a portion of the fat from the warm mass by pressure and reducing the residue to a powder, with or without addition of vanilla flavor.

"Dutch Process" Cocoa is cocoa treated with an alkali, usually soda or ammonia, to hinder the fat from collecting on the surface of the beverage prepared from it. This is sometimes called "soluble cocoa."

Cocoa butter is the expressed fat obtained as a by-product in the manufacture of cocoa.

Cocoa shells are used to some extent for the preparation of a beverage, but are usually regarded as a waste product and are often ground with cocoa products, spices, etc., as an adulterant.

Constituents of Cocoa Beans and Cocoa Products. The following table shows the average composition of pure commercial chocolate, plain and sweet, pure commercial cocoa, and cocoa shells, as determined by the writers:

	Pure plain chocolate. Average of 6 analyses.*	Pure sweet chocolate. Average of 12 analyses.†	Pure cocoa. Average of 26 analyses.‡	Cocoa shells (hand shelled). Average of 17 analyses.§
Water	3.78	2.17	6.23	4.87
Ash	3.15	1.40	5.49	10.43
Theobromin	0.78	0.35	1.15	0.49
Caffein	0.13	0.08	0.16	0.16
Other nitrogenous substances (protein)	12.36	4.58	18.34	14.46
Crude fiber	2.86	0.95	4.48	16.55
Sugar	0.00	56.44	0.00	0.00
Pure starch	8.11	2.88	11.14	4.13
Other nitrogen-free substances	16.64	7.64	26.32	46.15
Fat	52.19	23.51	26.69	2.76
	100.00	100.00	100.00	100.00

The quantity of sugar in sweet chocolate ranges from 50 to 70 per cent. and the quantities of other ingredients are consequently somewhat less than half as much as in unsweetened chocolate.

From the analyses it is clear that beverages made from chocolate and cocoa are valuable not merely for their stimulating properties, but also for their food ingredients, thus differing markedly from tea and coffee, which are of little value as foods. The solid matter of both products consists largely of fat, starch and protein, which if not the most digestible forms of these elements, as some manufacturers would have the public believe, are at least equal to the forms present in many other articles of diet.

Cocoa products owe their stimulating properties to two closely related alkaloids, theobromin and caffein, the former being the more abundant. Caffein is the chief alkaloid of both tea and coffee. It is a remarkable fact that the three most important non-alcoholic beverages, tea, coffee and cocoa, all contain stimulating principles, although their popularity is usually attributed largely to their agreeable flavors. The flavor of each is distinct and characteristic, but caffein is present in all of them, and theobromin, although present in considerable amount only in cocoa, is similar to caffein both in chemical composition and physiological action.

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* This report, p. 130.

† This report, p. 130.

‡ Report for 1902, p. 258.

§ Report for 1902, p. 284.

Standards. The following standards have been adopted by the Secretary of Agriculture of the United States, as authorized by Congress, by the Association of Official Agricultural Chemists of the United States and by this Station.

"Standard chocolate is chocolate containing not more than three (3) per cent. of ash insoluble in water, three and fifty hundredths (3.50) per cent. of crude fiber and nine (9) per cent. of starch; nor less than forty-five (45) per cent. of cocoa fat.

Standard sweet chocolate and standard chocolate coating are sweet chocolate and chocolate coating containing in the sugar- and fat-free residue no higher percentages of either ash, fiber or starch than is found in the sugar- and fat-free residue of plain chocolate.

Standard cocoa is cocoa containing percentages of ash, crude fiber and starch corresponding to those in chocolate, after correction for fat removed."

Adulteration of Chocolate and Cocoa. From the definitions and standards it is evident that chocolate must contain the full amount of cocoa butter present in the cocoa nibs, otherwise it is adulterated; while cocoa is understood to mean chocolate from which a portion of this cocoa butter has been extracted. This distinction is based on long established trade usage.

The addition of cocoa shells to either product, like the addition of pepper shells to pepper, is clearly an adulteration. Starch, flour and other diluents, or artificial colors, are also adulterants except in products so labeled as plainly to show that they contain foreign materials.

Chocolate or cocoa containing sugar should be labelled "sweet" or "sweetened," otherwise it is adulterated. Sugar, it should be remembered, costs but from one-eighth to one-tenth as much per pound as either chocolate or cocoa, so that the presence of any considerable amount of this material, unless cocoa butter is added at the same time, reduces materially the value of the product.

Another form of adulteration consists in removing a portion of the cocoa butter and adding in its stead some cheaper fat, such as cocoanut oil or tallow.

EXAMINATION OF SAMPLES.

During the year 1892, 45 brands of cocoa were examined, of which 26 were not found adulterated, 12 were variously adulterated and 7 were mixtures marked "compound." The results of these analyses appeared in the annual report for that year.

The samples examined during the present year with a single exception (Plasmon Cocoa) were labeled chocolate or preparations of chocolate. They are classified as follows:

	Plain.	Sweet.	Total
Chocolate not found adulterated	6	12	18
Adulterated chocolate	8	3	11
Compound chocolate	5	2	7
Chocolate and cocoa containing milk or casein	1	3	4
Total	20	20	40

Chocolate not found adulterated. (Tables I and V.) The samples classed under this head were free from foreign starchy matter, cocoa shells and other adulterants, as shown by microscopic examination, and also conformed in chemical composition to the standards. The minimum amount of fat in the plain chocolate was 50.36 per cent., the maximum amount of ash insoluble in water was 1.90 per cent., of crude fiber 3.17 per cent., and of starch 8.88 per cent.

The percentage of sugar in the sweet chocolates ranged from 50.60 to 63.88. Calculated to the water- and sugar-free material, the fat ranged from 52.12 to 67.37, showing that in no case had any fat been removed but that in a number of cases fat had been added in order to make it possible to incorporate more sugar with the chocolate. This fat in all cases had the chemical and physical properties of pure cocoa butter.

Adulterated Chocolate. (Tables II and VI.) All the samples of plain adulterated chocolate contained foreign starchy matter, which in 7 cases was wheat flour, in 1 case corn (maize) starch or flour. Because of this adulteration the percentages of pure starch (10.02-17.62) in all the samples were in excess of the standard amount (9 per cent.). In one instance (No. 7712), an excessive percentage of crude fiber (4.93) was also present. Five of the 8 samples were below standard in fat.

Of the samples of sweet chocolate, W. H. Baker's contained wheat flour, J. H. Barker & Co.'s Hasty Lunch Chocolate was a cocoa mixed with corn starch, and Rockwood & Co.'s Ground Chocolate was a cocoa sold, however, under the name chocolate.

Sample No. 7713, J. H. Barker's & Co.'s Hasty Lunch Chocolate, contained a small amount of corn starch.

A sample of the same brand, bought at about the same time of J. P. Hugo, 92 Nicoll street, New Haven, bore a label like the first sample but printed in a slightly different color, and was somewhat shopworn. This was not found adulterated. Immediately a second lot was bought of A. H. Waterbury, from whom No. 7713 was purchased, and was found adulterated with corn starch as before.

When Messrs. J. H. Barker & Co. were notified that Hasty Lunch Chocolate was found adulterated, their President, in a personal interview, stated that the firm had never made any but strictly pure preparations, that on December 27, 1902, their factory was burned, and that since then, while building a new factory, they had been obliged to buy all their chocolate and cocoa from other manufacturers and to pack and sell it under their own brands.

A statement from the manufacturers of whom they bought was shown, affirming that they were furnishing Messrs. J. H. Barker & Co. pure goods.

Within a few weeks, however, Barker & Co. had discovered that one of these firms had sold them cocoa powder containing starch, and in consequence suit had been brought against this firm.

Barker & Co. filed with the Station an affidavit of their Superintendent affirming that no adulteration whatever had been practiced or substitutes used within their factory.

We are also advised that Messrs. J. H. Barker & Co. ordered the withdrawal from the state of the goods in Waterbury's possession, which had been found adulterated.

All of the chocolates classed as adulterated are what is known in the trade as "premium chocolates." "Premium chocolate" at present means nothing more than a mass of plain chocolate with a blue wrapper and yellow label. It has been a practice of many reputable manufacturers, but not of all, as our tables of analyses show, to remove a portion of the cocoa fat from the premium chocolate or to add some starch, so that the goods may be more easily handled in hot weather. This practice has been well understood in the trade and not generally regarded as an attempt to defraud. Under the government standards, however, the word chocolate on a package, at least if not followed by a plain explanation regarding the contents of the package, means plain chocolate ("bitter chocolate," "chocolate liquor"), *free from admixture of any kind* and from which none of the cocoa butter or other ingredient originally present has been removed. If, therefore, premium chocolate contains any foreign starch or has had any of its cocoa fat removed, it is to be classed as adulterated. The Croft & Allen Co. of Philadelphia write regarding sample 7787, see table on page 136, that it is their practice to remove a portion of the fat in making Premium Chocolate, but that it contains no foreign substance whatever. This firm has changed the label of this brand to meet the requirements of the state law.

Compound Chocolate. (Tables III and VII.) The samples of plain chocolate were distinctly labelled as "compounds," with a statement in 2 instances as to composition. Our examination showed that 3 contained wheat flour and 2 a corn (maize) product. The New England Chocolate Co.'s Harvard Chocolate in addition to wheat flour contained a foreign fat, probably cocoanut oil.

Of the sweetened samples "Alkethrepta" was a mixture of cocoa with sugar and corn starch and Walker's Powdered Sweetened Family Chocolate was sweetened cocoa.

Chocolate and Cocoa containing Milk or Casein. (Tables V and VIII.) Peter's Milk Chocolate is one of several brands now on the market, containing chocolate, milk powder and sugar. Robert's Cream Chocolate is stated on the label to consist of cocoa, cream and sugar. Plasmon Chocolate contains chocolate, sugar, and casein, with a little corn starch. Plasmon Cocoa is a mixture of cocoa and casein. The casein or "plasmon" used in these and other products made by the same company is obtained from skim milk.

METHODS OF ANALYSIS.

Water. Dry 2 grams of the material to constant weight at 100° in a current of dry hydrogen.

Total Ash. Burn 2 grams in a muffle furnace at a heat below redness.

Ash Soluble in Water. Boil the ash prepared as above with 50 cc. of water. Collect the insoluble portion in a Gooch crucible, wash with hot water, dry, ignite and weigh. Subtract the percentage of insoluble ash thus determined from the percentage of total ash, thus obtaining the percentage of water-soluble ash.

Ash insoluble in Acid (Sand).[*] Incinerate 2 grams of the material as above directed, boil with 25 cc. of 10 per cent. hydrochloric acid (sp. gr. 1,050) for five minutes, collect the insoluble matter in a Gooch crucible, wash with hot water, ignite and weigh.

Alkalinity of the Ash (Ewell's Method).[†] Reduce 2 grams to an ash, as described above. Add 100 cc. of water, an excess of standard decinormal sulphuric acid and boil until the carbonic acid is removed. Titrate the excess of acid with standard decinormal potassium hydrate solution. Calculate the number of cc. of decinormal acid required to neutralize the ash from one gram of the original material.

Theobromin and Caffein (Decker-Kunze Method).[‡] Boil 10 grams of the powdered material and 5 grams of calcined magnesia for 30 minutes with 300 cc. of water. Filter by the aid of suction on a Buchner funnel, using a round disk of filter paper. Transfer the material and paper to the same flask used for the first boiling, add 150 cc. of water and boil 15 minutes. Filter as before and repeat the operation of boiling with 150 cc. of water and filtering. Wash once or twice with hot water. Evaporate the united filtrates (with quartz sand if sugar be present), to complete dryness in a thin glass dish of about 300 cc. capacity.[§]

Grind to a coarse powder in a mortar provided with a suitable cover to prevent loss by flying. Transfer to the inner tube of a Tollens, Johnson, or Wiley fat extractor, and dry thoroughly in a water oven. Extract with chloroform for eight hours, or until the theobromin and caffein are completely removed, into a weighed flask. It is important that the material be thoroughly dry, that an extractor be used that permits of a hot extraction, and that a considerable volume of chloroform passes through the material. Distil off the chloroform, and dry at 100° C. to constant weight. (*Continued on page 141.*)

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[*] Report of this Station for 1898, 186. U. S. Dept. Agr., Bur. Chem., Bul. 65, 55.

[†] U. S. Dept. Agr., Div. Chem., Bul. 13, Part 7, 956.

[‡] Schweiz. Wchshr. Phar., 1902, 40, 527-530, 541-545, 553-557; Abstract Chem. Centr., 1903, 74, 62.

[§] A "Hoffmeister Schälchen" may be used, or dishes may be made from broken flasks by making a scratch with a diamond and leading a crack from this scratch about the flask by means of a glowing spring-coal.

TABLE I.—CHOCOLATE NOT FOUND ADULTERATED.

Station No.	Brand.	Dealer.	Price per half pound, cents.
	Plain Chocolate.		
7781	Walter Baker & Co., Dorchester, Mass. Baker's Chocolate	*Stamford:* R. T. Woodbury, 107 Pacific st.	18
7782	Huyler's Premium Chocolate, New York	W. W. Waterbury, 501 Main st.	18
7790	Chocolat-Menier, Premium No. 1	*Danbury:* Ehle's Cash Store, 7 West st.	25
7721	Puritan Pure Food Co., New York. Chocolate	*Meriden:* M. W. Booth, 41 E. Main st.	20
7779	Runkel Bros., New York. Premium Baking Chocolate	*Norwalk:* Grand Central Cash Grocery, 19 Main st.	18
7775	H. O. Wilbur & Sons, Phila. Wilbur's Baking Chocolate	*Bridgeport:* E. E. Wheeler, 1135 Main st.	16
	Sweet Chocolate.		
7780	Walter Baker & Co., Dorchester, Mass. German Sweet Chocolate	*Norwalk:* Conrad Becker, 141 Washington st.	16
7794	Bensdorp & Co., Amsterdam. Sweet Vanilla Chocolate	*Norwich:* H. D. Rallion, 45 Broadway	20
7719	Groote's Sweet Vanilla Chocolate	*Meriden:* C. N. Dutton & Co., 17 Colony st.	30
7720	Hooton Cocoa & Chocolate Co., Newark. Uncle Sam Sweet Chocolate*	Meriden Tea & Coffee Co., 77 E. Main st.	20
7786	Huyler's Vanilla Chocolate, New York	*Willimantic:* Samuel Chesebro, 745 Main st.	25
7715	Lowney's Vanilla Sweet Chocolate	*New Britain:* Wm. Foulds, 236 Park st.	20
7783	Manhattan Cocoa & Chocolate Mills, New York. Imperial French Sweet Chocolate	*Stamford:* Empire State Tea Co., 303 Main st.	13
7778	Puritan Pure Food Co., New York. Sweet Chocolate	*Norwalk:* New York Cash Grocery, 35–37 Main st.	20
7776	Runkel Bros., New York. Vienna Sweet Chocolate	*Bridgeport:* Atlantic & Pacific Tea Co., Main st.	12
7777	Josiah Webb & Co., Ltd., Milton, Mass. French Sweet Chocolate, Cinquième	*Southport:* Meeker's Cash Grocery	20
7788	Stephen F. Whitman & Son, Phila. Whitman's Instantaneous Chocolate	*Hartford:* Hills & Co., Asylum st.	20
7718	H. O. Wilbur & Sons, Phila., Chicago and N. Y. Wilbur's Vanilla Sweet Clover Chocolate	*Meriden:* H. E. Bushnell, 75–79 W. Main st.	20

* "Made from 40% cocoa nibs, 60% sugar."

TABLE II.—ADULTERATED CHOCOLATE.

Station No.	Brand.	Dealer.	Price per half pound, cents.	Nature of Adulteration.
	Plain Chocolate.			
7711	W. H. Baker, Winchester, Va. Best Quality, Premium No. 1	*New Haven:* Mendel & Freedman, 770–774 Chapel st.	15	Wheat flour.
7784	W. H. Baker, Winchester, Va. Best Quality, Premium No. 1	*Middletown:* Middletown Cash Grocery, 354 Main st.	18	Wheat flour.
7803	William H. Baker, Syracuse. Justice Brand Chocolate, Premium No. 1	*Waterbury:* Union Supply Co., 118 South Main st.	18	Wheat flour.
7787	Croft & Allen, Phila. Premium Chocolate*	*Willimantic:* Geo. R. Tripp, 798 Main st.	20	Wheat flour.
7712	W. Hardy & Co., Pleasantville, N. Y. Hardy's Premium Chocolate	*New Haven:* S. S. Adams, State and Court sts.	15	Wheat flour.
7774	Lipscomb-Speights Co., Augusta, Ga. Chosen Few No. 1 Premium Chocolate	*Bridgeport:* H. Isenberg & Co., 109 State st.	18	Corn starch.
7710	Jas. G. Powers & Co., New York. Red Shield No. 1 Premium Chocolate	*New Haven:* The Three G's Cash Store, 23–27 Edwards st.	18	Wheat flour.
7716	Rockwood & Co., New York. Premium Chocolate	*Hartford:* City Hall Cash Grocery, 42 State st.	20	Wheat flour.
	Sweet Chocolate.			
7789	W. H. Baker, Winchester, Va. Best Sweet Chocolate	*Danbury:* R. E. Church, 147 Main st.	20	Wheat flour.
7713	J. H. Barker & Co., Brooklyn. Hasty Lunch Chocolate†	*New Haven:* A. H. Waterbury, Grand ave. and Poplar st.	15	Corn starch. Fat partially extracted.
7798	Rockwood & Co., New York. Pure Ground Chocolate	*Hartford:* Newton, Robertson & Co., 338–342 Asylum st.	13	Fat partially extracted.

* See note, page 129. † See page 128.

TABLE III.—COMPOUND CHOCOLATE.

Station No.	Brand.	Dealer.	Price per half pound, cents.	Constituents other than chocolate and sugar.
	Plain Chocolate.			
7791	Crave & Martin Co., New York. No. 1 Premium Chocolate, Improved Compound Preparation	*Danbury:* Ehle's Cash Store, 7 West st.	15	Wheat flour.
7795	The Mohican Co., Premium No. 1 Chocolate*	*Norwich:* The Mohican Co., 264 Main st.	15	Corn starch.
7785	Mohican Co., New York, No. 1 Premium Chocolate, Improved Compound Preparation	*New Haven:* Mohican Co., 18 Church st.	15	Wheat flour.
7773	New England Chocolate Co., Winthrop, Mass.; Harvard Plain Chocolate. A Compound	*Bridgeport:* National Cash Grocery, 52 Cannon st.	20	Wheat flour; foreign fat.
7793	Empire Chocolate Mills, New York. Winthrop Premium No. 1 Chocolate†	*New London:* N. Y. Cash Grocery, 179 Bank st.	18	Corn starch.
	Sweet Chocolate.			
7717	Smith's Mfg. Co., New York, Alkethrepta. A Pure Preparation of Chocolate	*Hartford:* Newton, Robertson & Co., 338 Asylum st.	30	Corn starch.
7802	Atkinson & Co., Inc., Sherman Park, N. Y. Walker's Powdered Sweetened Family Chocolate‡	*Hartford:* Boston Grocery, 751 Main st.	..	Fat partially extracted.

* " A wholesome compound of 90% Cocoa bean, 10% cereal flour." † "90% cocoa bean, 10% corn starch."

‡ " This preparation contains 4 parts pure cocoa with about 30% of the oil extracted, and 6 parts pure cane sugar."

TABLE IV.—CHOCOLATE AND COCOA PREPARATIONS CONTAINING MILK OR CASEIN.

Station No.	Brand.	Dealer.	Price per half pound, cents.	Constituents.
7714	D. Peter, Vevey, Switzerland. The Original Milk-Chocolate	*New Haven:* Boston Grocery, 926 Chapel st.	30	Chocolate; milk solids.
7801	Plasmon Company, New York. Plasmon Chocolate*	*Hartford:* Wise, Smith & Co., 915 Main st.	20	Chocolate; casein; corn starch.
7804	Plasmon Company, New York. Plasmon Cocoa	*Hartford:* Boston Grocery, 745-751 Main st.	25	Cocoa; casein.
7796	L. A. Roberts & Co., Danvers, Mass. Roberts' Cream Chocolate	*Norwich:* H. D. Rallion, 45 Broadway	22	Cocoa; milk solids.

* "Contains 25% plasmon."

TABLE V.—ANALYSES OF CHOCOLATE NOT FOUND ADULTERATED.

Station No.		In the Air-Dry Material.																
			Ash.														Polarization at 20° C.	
		Water.	Total.	Soluble in water.	Insoluble in acid (sand).	Alkalinity.	Theobromin.	Caffein.	Other nitrogenous substances.	Crude fiber.	Crude starch.	Pure starch.	Sugar.	Other nitrogen-free substances.	Fat.	Total nitrogen.	Direct.	After inversion.
		%	%	%	%		%	%	%	%	%	%	%	%	%	%		
	Plain Chocolate.																	
7781	Walter Baker & Co.'s	3.50	2.89	1.32	0.00	1.85	0.68	0.14	12.12	2.72	11.57	8.26	0.00	15.95	53.74	2.19	0.	0.
7782	Huyler's Premium	4.25	3.37	1.67	0.18	1.95	0.74	0.10	12.19	3.04	11.48	7.87	0.00	17.62	50.82	2.21	0.	0.
7790	Menier, Premium No. 1	4.44	2.83	1.19	0.07	1.80	0.73	0.09	12.00	2.74	11.66	8.18	0.00	15.27	53.72	2.18	0.	0.
7721	Puritan Pure Food Co.'s	3.85	3.54	1.60	0.05	2.00	0.87	0.13	12.87	2.87	11.10	7.47	0.00	18.04	50.36	2.37	0.	0.
7779	Runkel Bros.' Premium	3.24	3.12	1.42	0.03	2.00	0.79	0.18	12.25	3.17	11.96	8.00	0.00	16.05	53.20	2.26	0.	0.
7775	Wilbur's	3.43	3.12	1.30	0.02	2.00	0.84	0.12	12.75	2.64	12.05	8.88	0.00	16.92	51.30	2.33	0.	0.
	Maximum	4.44	3.54	1.67	0.18	2.00	0.87	0.18	12.87	3.17	12.05	8.88	0.00	18.04	53.74	2.37	0.	0.
	Minimum	3.24	2.83	1.19	0.02	1.80	0.68	0.09	12.00	2.64	11.10	7.47	0.00	15.27	50.36	2.18	0.	0.
	Average	3.78	3.15	1.41	0.06	1.93	0.78	0.13	12.36	2.86	11.63	8.11	0.00	16.64	52.19	2.26	0.	0.
	Sweet Chocolate.																	
7780	Walter Baker & Co.'s German	2.00	1.11	0.68	0.00	0.80	0.37	0.06	4.56	0.77	4.39	3.09	56.04	8.65	23.35	0.87	+58.3	—16.8
7794	Bensdorp & Co.'s Vanilla	2.32	1.47	0.87	0.10	1.10	0.30	0.08	3.87	1.20	3.85	2.71	57.24	7.33	23.48	0.73	+59.0	—17.7
7719	Groote's Vanilla	2.01	1.46	0.77	0.10	1.05	0.34	0.10	4.31	0.81	4.01	2.83	56.20	7.07	24.87	0.83	+57.6	—17.7
7720	Hooton Co.'s Uncle Sam	1.82	1.29	0.68	0.01	1.10	0.32	0.08	4.19	0.79	4.05	2.94	58.58	7.57	22.42	0.79	+60.0	—18.5
7786	Huyler's Vanilla	1.97	1.22	0.63	0.03	0.95	0.30	0.11	4.31	1.04	3.71	2.67	56.94	6.10	25.34	0.81	+58.6	—17.7
7715	Lowney's Vanilla	1.90	0.96	0.55	0.00	1.30	0.34	0.04	3.31	0.86	3.17	2.11	59.70	4.91	25.87	0.65	+61.0	—19.0
7783	Manhattan Mills' Imperial	2.14	1.24	0.76	0.03	0.85	0.34	0.03	3.87	0.72	3.41	2.28	63.88	6.19	19.31	0.74	+65.6	—20.0
7778	Puritan Pure Food Co.'s	2.00	1.35	0.82	0.01	1.10	0.33	0.09	5.44	0.89	4.81	3.49	51.41	8.41	26.59	1.00	+53.0	—15.9
7776	Runkel Bros.' Vienna	2.11	1.43	0.76	0.04	0.85	0.36	0.03	4.69	0.74	3.86	2.66	60.22	7.67	20.09	0.87	+61.8	—18.9
7777	Josiah Webb & Co.'s French	2.39	2.00	0.99	0.13	1.45	0.37	0.07	5.25	1.47	4.58	2.31	51.12	10.79	24.23	0.98	+53.8	—15.7
7788	Whitman's Instantaneous	2.71	1.66	0.90	0.04	1.25	0.43	0.14	5.81	1.53	5.44	4.02	50.60	8.51	24.59	1.10	+51.9	—15.9
7718	Wilbur's Vanilla	2.66	1.63	0.86	0.06	1.20	0.34	0.10	5.31	0.73	4.70	3.46	55.37	8.47	21.93	0.99	+56.5	—17.7
	Maximum	2.71	2.00	0.99	0.13	1.45	0.43	0.14	5.81	1.53	5.44	4.02	63.88	10.79	26.59	1.10	+65.6	—20.0
	Minimum	1.82	0.96	0.55	0.00	0.80	0.30	0.03	3.31	0.72	3.17	2.11	50.60	4.91	19.31	0.65	+51.9	—15.7
	Average	2.17	1.40	0.77	0.05	1.08	0.35	0.08	4.58	0.96	4.16	2.88	56.44	7.64	23.51	0.86	+58.1	—17.6

Table V.—Analyses of Chocolate not Found Adulterated—*Continued.*

Station No.		In the Water- and Sugar-Free Material.													Constants of Fat (Ether extract).			
		Ash.																
		Total.	Soluble in water.	Insoluble in acid (sand).	Alkalinity.	Theobromin.	Caffein.	Other nitrogenous substances.	Crude fiber.	Crude starch.	Pure starch.	Other nitrogen-free substances.	Fat.	Total nitrogen.	Melting point, degrees C.	Zeiss refractometer reading at 40° C.	Refractive index at 40° C.	Iodine number.
		%	%	%		%	%	%	%	%	%	%	%	%				
	Plain Chocolate.																	
7781	Walter Baker & Co.'s	2.98	1.37	0.00	1.92	0.71	0.15	12.55	2.82	11.98	8.56	16.53	55.70	2.27	31.50	47.50	1.4576	35.70
7782	Huyler's Premium	3.52	1.74	0.19	2.04	0.77	0.10	12.73	3.18	12.00	8.22	18.40	53.08	2.31	29.50	46.75	1.4570	36.01
7790	Menier, Premium No. 1	2.96	1.24	0.07	1.88	0.76	0.09	12.56	2.87	12.20	8.56	15.98	56.22	2.28	30.50	47.00	1.4572	35.27
7721	Puritan Pure Food Co.'s	3.68	1.66	0.05	2.08	0.90	0.14	13.39	2.98	11.55	7.77	18.76	52.38	2.46	29.50	47.00	1.4572	36.53
7779	Runkel Bros.' Premium	3.21	1.47	0.03	2.07	0.82	0.19	12.66	3.28	12.36	8.27	16.59	54.98	2.34	31.50	47.00	1.4572	36.10
7775	Wilbur's	3.23	1.35	0.02	2.07	0.87	0.12	13.20	2.73	12.48	9.20	17.52	53.13	2.41	30.00	46.75	1.4570	35.75
	Maximum	3.68	1.74	0.19	2.08	0.90	0.19	13.39	3.28	12.48	9.20	18.76	56.22	2.46	31.50	47.50	1.4576	36.53
	Minimum	2.96	1.24	0.00	1.88	0.71	0.09	12.55	2.73	11.55	7.77	15.98	52.38	2.27	29.50	46.75	1.4570	35.27
	Average	3.26	1.47	0.06	2.01	0.80	0.13	12.85	2.98	12.09	8.43	17.30	54.25	2.34	30.40	47.00	1.4572	35.89
	Sweet Chocolate.																	
7780	Walter Baker & Co.'s German	2.65	1.62	0.00	1.91	0.88	0.14	10.87	1.83	10.46	7.36	20.62	55.65	2.07	31.00	46.75	1.4570	35.95
7794	Bensdorp & Co.'s Vanilla	3.63	2.15	0.25	2.72	0.74	0.20	9.57	2.97	9.52	6.70	18.13	58.06	1.81	31.00	47.25	1.4574	37.37
7719	Groote's Vanilla	3.49	1.84	0.24	2.51	0.81	0.24	10.31	1.94	9.60	6.77	16.93	59.51	1.99	29.50	47.00	1.4572	33.76
7720	Hooton Co.'s Uncle Sam	3.26	1.72	0.02	2.78	0.81	0.20	10.58	1.99	10.23	7.42	19.12	56.62	1.99	30.00	46.75	1.4570	34.64
7786	Huyler's Vanilla	2.97	1.53	0.07	2.31	0.73	0.27	10.49	2.53	9.03	6.50	14.84	61.67	1.97	29.50	46.25	1.4567	35.55
7715	Lowney's Vanilla	2.50	1.43	0.00	3.38	0.89	0.10	8.62	2.24	8.26	5.49	12.79	67.37	1.69	30.00	47.00	1.4572	34.46
7783	Manhattan Mills' Imperial	3.65	2.24	0.09	2.50	1.00	0.09	11.39	2.12	10.00	6.71	18.21	56.83	2.18	30.50	47.25	1.4574	39.56
7778	Puritan Pure Food Co.'s	2.90	1.76	0.02	2.36	0.70	0.19	11.68	1.91	10.32	7.49	18.05	57.08	2.15	31.00	47.00	1.4572	36.05
7776	Runkel Bros.' Vienna	3.80	2.02	0.12	2.26	0.96	0.08	12.45	1.96	10.25	7.06	20.36	53.33	2.31	30.50	47.25	1.4574	36.00
7777	Josiah Webb & Co.'s French	4.30	2.13	0.28	3.12	0.80	0.15	11.29	3.16	9.85	4.98	23.20	52.12	2.11	28.50	47.25	1.4574	35.95
7788	Whitman's Instantaneous	3.55	1.93	0.09	2.68	0.92	0.30	12.45	3.28	11.65	8.61	18.23	52.66	2.36	31.00	47.00	1.4572	34.50
7718	Wilbur's Vanilla	3.88	2.05	0.15	2.86	0.81	0.24	12.66	1.74	11.20	8.24	20.18	52.25	2.36	31.00	47.00	1.4572	32.92
	Maximum	4.30	2.24	0.28	3.38	1.00	0.30	12.66	3.28	11.65	8.61	23.20	67.37	2.36	31.00	47.25	1.4574	39.56
	Minimum	2.50	1.43	0.00	1.91	0.70	0.08	8.62	1.74	8.26	4.98	12.79	52.12	1.69	28.50	46.25	1.4567	32.92
	Average	3.38	1.87	0.11	2.62	0.84	0.17	11.03	2.31	10.03	6.94	18.39	56.93	2.08	30.30	46.98	1.4572	35.56

TABLE VI.—ANALYSES OF ADULTERATED CHOCOLATE.

Station No.		In the Air-Dry Material.																
			Ash.														Polarization at 20° C.	
		Water.	Total.	Soluble in water.	Insoluble in acid (sand).	Alkalinity.	Theobromin.	Caffein.	Other nitrogenous substances.	Crude fiber.	Crude starch.	Pure starch.	Sugar.	Other nitrogen-free substances.	Fat.	Total nitrogen.	Direct.	After inversion.
		%	%	%	%		%	%	%	%	%	%	%	%	%	%		
	Plain Chocolate.																	
7711	W. H. Baker's Best Quality	5.73	2.87	1.30	0.01	1.75	0.53	0.18	13.56	2.99	19.32	16.69	0.00	14.73	42.72	2.38	0.	0.
7784	W. H. Baker's Best Quality	4.77	2.85	1.49	0.02	1.80	0.54	0.16	12.81	3.44	20.79	17.42	0.00	15.99	42.02	2.27	0.	0.
7803	Wm. H. Baker's Justice Brand, Premium No. 1	6.59	3.02	1.33	0.07	1.65	0.70	0.16	13.44	2.63	21.60	17.64	0.00	15.13	40.69	2.42	0.	0.
7787	Croft & Allen's Premium	4.03	3.45	1.39	0.03	1.65	1.07	0.12	14.00	3.30	13.50	10.02	0.00	21.69	42.32	2.60	0.	0.
7712	Hardy's Premium	5.12	3.72	1.58	0.13	2.25	0.70	0.09	13.50	4.93	18.05	13.61	0.00	20.92	37.41	2.41	0.	0.
7774	Lipscomb-Speights Co.'s Chosen Few, No. 1, Premium	3.66	2.96	1.25	0.08	1.85	0.56	0.05	11.31	2.42	19.11	15.03	0.00	17.53	46.48	1.99	0.	0.
7710	Jas. G. Powers & Co.'s Red Shield, No. 1, Premium	4.26	3.13	1.43	0.04	2.15	0.62	0.12	12.44	3.40	16.36	12.95	0.00	16.92	46.16	2.21	0.	0.
7716	Rockwood & Co.'s	4.67	3.20	1.38	0.06	1.85	0.64	0.11	12.56	2.81	16.68	13.21	0.00	17.27	45.53	2.24	0.	0.
	Sweet Chocolate.																	
7789	W. H. Baker's	2.77	1.26	1.33	0.00	0.85	0.33	0.08	5.94	1.39	8.85	7.31	53.43	5.64	21.85	1.07	+54.6	−17.0
7713	J. H. Barker & Co.'s Hasty Lunch	2.61	2.15	0.99	0.11	1.50	0.56	0.11	8.81	2.04	7.69	5.48	53.06	13.40	11.78	1.61	+54.9	−16.2
7798	Rockwood & Co.'s Ground	2.63	1.99	1.00	0.06	1.40	0.44	0.11	7.31	1.61	6.16	4.39	59.92	9.81	11.79	1.34	+61.4	−18.9

TABLE VI.—ANALYSES OF ADULTERATED CHOCOLATE—*Continued.*

Station No.		IN THE WATER- AND SUGAR-FREE MATERIAL.														CONSTANTS OF FAT (Ether extract).		
		Ash.																
		Total.	Soluble in water.	Insoluble in acid (sand).	Alkalinity.	Theobromin.	Caffein.	Other nitrogenous substances.	Crude fiber.	Crude starch.	Pure starch.	Other nitrogen-free substances.	Fat.	Total nitrogen.	Melting point, degrees C.	Zeiss refractometer reading at 40° C.	Refractive index at 40° C.	Iodine number.
		%	%	%		%	%	%	%	%	%	%	%	%				
	Plain Chocolate.																	
7711	W. H. Baker's Best Quality	3.04	1.38	0.01	1.86	0.56	0.19	14.38	3.17	20.49	17.70	15.63	45.33	2.52	30.50	46.75	1.4570	35.83
7784	W. H. Baker's Best Quality	2.99	1.56	0.02	1.89	0.57	0.17	13.45	3.61	21.83	18.30	16.79	44.12	2.38	32.00	47.50	1.4576	37.84
7803	Wm. H. Baker's Justice Brand, Premium No. 1	3.23	1.42	0.08	1.77	0.75	0.17	14.39	2.81	23.12	18.88	16.21	43.56	2.59	31.75	47.00	1.4572	37.83
7787	Croft & Allen's Premium	3.59	1.45	0.03	1.72	1.11	0.13	14.59	3.44	14.07	10.44	22.60	44.10	2.71	28.50	47.00	1.4572	38.26
7712	Hardy's Premium	3.92	1.67	0.14	2.37	0.74	0.09	14.23	5.20	19.02	14.34	22.05	39.43	2.54	30.00	47.00	1.4572	38.56
7774	Lipscomb-Speights Co.'s Chosen Few, No. 1, Premium	3.07	1.30	0.08	1.92	0.58	0.05	11.74	2.51	19.84	15.60	18.20	48.25	2.07	31.50	46.50	1.4569	37.46
7710	Jas. G. Powers & Co.'s Red Shield, No. 1, Premium	3.27	1.49	0.04	2.25	0.65	0.13	12.99	3.55	17.09	13.53	17.66	48.22	2.31	30.00	47.00	1.4572	38.76
7716	Rockwood & Co.'s	3.36	1.45	0.06	1.94	0.67	0.12	13.17	2.95	17.50	13.86	18.11	47.76	2.35	30.00	47.75	1.4578	38.41
7789	*Sweet Chocolate.*																	
7713	W. H. Baker's	2.88	3.04	0.00	1.94	0.75	0.18	13.56	3.17	20.21	16.69	12.88	49.89	2.44	29.50	47.00	1.4572	35.91
7798	J. H. Barker & Co.'s Hasty Lunch	4.85	2.23	0.25	3.38	1.26	0.25	19.89	4.60	17.35	12.36	30.22	26.57	3.63	30.00	47.75	1.4578	37.98
	Rockwood & Co.'s Ground	5.31	2.67	0.16	3.74	1.18	0.29	19.53	4.30	16.45	11.73	26.18	31.48	3.58	30.50	47.25	1.4574	35.51

TABLE VII.—ANALYSES OF COMPOUND CHOCOLATE.

Station No.		In the Air-Dry Material.															
			Ash.													Polarization at 20° C.	
		Water.	Total.	Soluble in water.	Insoluble in acid (sand).	Alkalinity.	Theobromin.	Caffein.	Other nitrogenous substances.	Crude fiber.	Crude starch.	Pure starch.	Sugar.	Other nitrogen-free substances.	Fat.	Total nitrogen.	Direct.	After inversion.
		%	%	%	%		%	%	%	%	%	%	%	%	%	%		
	Plain Chocolate.																	
7791	Crave & Martin Co.'s Champion No. 1, Premium	4.58	3.12	1.34	0.03	1.85	0.73	0.18	12.69	2.93	15.32	11.74	0.00	16.49	47.54	2.31	0.	0.
7795	The Mohican Co.'s Premium No. 1	6.39	3.64	1.80	0.29	2.45	0.46	0.11	10.06	3.32	24.40	20.11	0.00	15.97	39.94	1.79	0.	0.
7785	Mohican Co.'s No. 1, Premium	3.65	3.27	1.40	0.15	2.00	0.69	0.06	13.37	3.20	16.66	12.84	0.00	17.22	45.70	2.37	0.	0.
7773	New England Co.'s Harvard	4.01	3.96	1.53	0.14	1.95	0.88	0.09	13.81	3.64	14.00	10.53	0.00	18.47	44.61	2.51	0.	0.
7793	Empire Mills' Winthrop Premium, No. 1	5.05	3.04	1.25	0.24	2.00	0.48	0.05	9.25	2.99	26.35	23.12	0.00	15.08	40.94	1.64	0.	0.
	Sweet Chocolate.																	
7717	Smith's Mfg. Co.'s Alkethrepta	5.64	1.12	0.58	0.01	0.70	0.32	0.03	4.44	0.96	24.76	22.84	41.34	7.63	15.68	0.82	+42.2	−13.2
7802	Walker's	2.41	1.21	0.52	0.08	0.85	0.32	0.05	4.50	1.10	4.34	3.13	71.04	6.65	9.59	0.83	+73.0	−22.2

TABLE VII.—ANALYSES OF COMPOUND CHOCOLATE.—*Continued.*

Station No.		IN THE WATER- AND SUGAR-FREE MATERIAL.													CONSTANTS OF FAT. (Ether extract.)			
		Ash.				Theobromin.	Caffein.	Other nitrogenous substances.	Crude fiber.	Crude starch.	Pure starch.	Other nitrogen-free substances.	Fat.	Total nitrogen.	Melting point, degrees C.	Zeiss refractometer reading at 40° C.	Refractive index at 40° C.	Iodine number.
		Total.	Soluble in water.	Insoluble in acid (sand).	Alkalinity.													
		%	%	%		%	%	%	%	%	%	%	%	%				
	Plain Chocolate.																	
7791	Crave & Martin Co.'s Champion No. 1, Premium	3.27	1.40	0.03	1.94	0.77	0.19	13.30	3.07	16.06	12.30	17.27	49.83	2.42	30.50	47.25	1.4574	37.72
7795	The Mohican Co.'s Premium No. 1	3.89	1.92	0.31	2.62	0.49	0.12	10.75	3.55	26.06	21.48	17.06	42.66	1.91	30.00	47.25	1.4574	35.01
7785	Mohican Co.'s No. 1 Premium	3.39	1.45	0.16	2.08	0.72	0.06	13.88	3.32	17.29	13.33	17.86	47.44	2.46	31.00	47.00	1.4572	36.37
7773	New England Co.'s Harvard	4.13	1.59	0.15	2.03	0.92	0.09	14.39	3.79	14.59	10.97	19.24	46.47	2.61	29.50	43.50	1.4548	26.05
7793	Empire Mills' Winthrop Premium, No. 1	3.20	1.32	0.25	2.11	0.51	0.05	9.74	3.15	27.75	24.35	15.88	43.12	1.73	30.50	47.50	1.4576	38.20
	Sweet Chocolate.																	
7717	Smith's Mfg. Co.'s Alkethrepta	2.11	1.09	0.02	1.32	0.60	0.06	8.37	1.81	46.70	43.08	14.39	29.58	1.54	31.50	46.00	1.4565	31.38
7802	Walker's	4.56	1.96	0.30	3.20	1.20	0.19	16.95	4.14	16.35	11.79	25.05	36.12	3.12	30.00	47.25	1.4574	35.23

TABLE VIII.—ANALYSES OF CHOCOLATE AND COCOA PREPARATIONS CONTAINING MILK OR CASEIN.

Station No.		In the Air-Dry Material.															
			Ash.													Polarization at 20° C.	
		Water.	Total.	Soluble in water.	Insoluble in acid (sand).	Alkalinity.	Theobromin.	Caffein.	Other nitrogenous substances.	Crude fiber.	Crude starch.	Pure starch.	Sugar.	Other nitrogen-free substances.	Fat.	Total nitrogen.	Direct.	After inversion.
7714	Peter's Milk Chocolate...	3.25	1.98	0.75	0.00	1.00	0.32	0.04	8.37	0.81	3.19	2.75	....	....	31.28*	1.45	+44.9	− 7.5
7801	Plasmon Chocolate	3.46	2.49	0.41	0.23	1.25	0.25	0.08	19.87	0.67	3.05	2.36	40.97	4.74	25.11†	3.28	+41.6	−13.3
7804	Plasmon Cocoa.................	8.87	6.61	0.98	0.03	1.80	0.44	0.08	51.81	1.90	7.60	5.05	....	....	10.82‡	8.45	0.	0.
7796	Roberts' Cream Chocolate	3.27	1.54	0.81	0.07	1.00	0.38	0.06	6.19	1.05	4.08	3.00	....	....	11.10§	1.13	+67.0	−18.4

* Melting point 30° C.; Refraction 46.25; Refractive index 1.4567; Iodine number 34.70.
† " " 31.5 " 47. " " 1.4572 " " 36.57.
‡ " " 30. " 47.25 " " 1.4574 " " 35.71.
§ " " 30. " 47. " " 1.4572 " " 38.88.

If the material be shelled cocoa beans, pure chocolate or cocoa, the extract thus obtained is practically pure theobromin and caffein, but if the material is cocoa shells or a cocoa product mixed with a large amount of shells, the extract may be brown in color, due to the presence of considerable amounts of impurities.

In either case, separate the caffein by treating the extract in the flask at the room temperature for some hours with 50 cc. of pure benzol. Filter through a small paper into a tared dish, evaporate to dryness and dry to constant weight at 100° C., thus obtaining the amount of caffein.

Determine theobromin by Kunze's* method, as follows:

Add to the residue and paper 150 cc. of water, enough ammonia water to make the liquid slightly alkaline and an excess of decinormal silver nitrate solution. Boil to half the original volume, add 75 cc. of water and repeat the boiling. The solution should be perfectly neutral. If it contains the slightest amount of free ammonia, add water and boil until it is completely removed.

Filter from the insoluble silver theobromin compound and wash with hot water. In the filtrate determine the excess of silver nitrate by Volhard's† method as follows:

Add 5 cc. of cold saturated solution of ferric ammonium sulphate (ferric-ammonium alum) and enough boiled nitric acid to bleach the liquid. Titrate with decinormal ammonium sulphocyanide solution until a permanent red color appears.

1 cc. of decinormal $AgNO_3$ solution is equivalent to 0.01802 grams of theobromin. If the mixed alkaloids were colorless, the theobromin obtained by subtracting the weight of caffein from the weight of the mixed alkaloids will usually agree closely with that obtained by silver titration.

Other Nitrogenous Substances. Add the percentages of nitrogen present as theobromin and caffein,‡ subtract the sum from the total nitrogen found and multiply the remainder by 6.25.

Crude Fiber. The method is that adopted by the Association of Official Agricultural Chemists for the analysis of cattle foods, except that the fiber is filtered and weighed on a paper rather than on a Gooch crucible, since the latter is liable to clog, rendering filtration impossible.

Place the residue from the determination of ether extract in a 500-cc. Erlenmeyer flask, and add 200 cc. of boiling 1.25 per cent. sulphuric acid. Loosely cover the flask, heat at once to gentle boiling, and continue the boiling thirty minutes. Filter on a paper, wash with hot water, and rinse back into the same flask with 200 cc. of boiling 1.25 per cent. sodium hydroxide solution, nearly free from carbonate. After boiling, as before, for thirty minutes, collect the fiber on a weighed paper, thoroughly wash with hot water, and finally with a little alcohol and ether. Dry to constant weight at 100° C., and weigh. Deduct the

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[*] Ztschr. f. anal. Chem., 1894, 33, 1.

[†] Ztschr. f. anal. Chem., 1874, 13, 171.

[‡] Percentage of theobromin multiplied by 0.311, and percentage of caffein multiplied by 0.289, give percentage of nitrogen.

amount of ash in the fiber, as determined by incineration, from the total weight.

Determine the loss in weight sustained by the paper on treatment with sodium-hydroxide solution, alcohol and ether, and introduce the necessary correction, if any.

Crude Starch (*Copper-Reducing Matters by Direct Inversion Calculated as Starch.*) Weigh 4 grams of the product if unsweetened, or 10 grams if sweetened, into a small Wedgewood mortar, add 25 cc. of ether and grind with a pestle. After the coarser material has settled out decant off the ether with the fine suspended matter on a 11 cm. filter paper. Repeat this treatment several times until no more coarse material remains. After the ether has evaporated from the filter, transfer the fat-free residue to the mortar by means of a jet of cold water and rub to an even paste. Filter the liquid on the paper previously employed. Repeat the process of transferring from the filter to the mortar, grinding and filtering, until all sugar is removed. Proceeding in this manner, all fat and sugar are removed and any error due to caking of the material is obviated. In the case of sweetened products, the filtrate should measure at least 500 cc.

Transfer the residue to a flask of 500 cc. capacity with 200 cc. of water, convert the starch into dextrose by the Sachsse method,* as follows:

Add 20 cc. of 25 per cent. hydrochloric acid (sp. gr. 1.125) and heat for three hours in a boiling water-bath. Care should be taken that the flask is surrounded by boiling water to the height of the liquid within or otherwise treated so that the solution is heated within a degree or two of 100° C. Cool the solution, nearly neutralize with sodium hydroxide solution, add 5 cc. of basic acetate solution,† make up to 250 cc. in a graduated flask, and filter through a dry paper. To 100 cc. of the filtrate, add 1 cc. of 60 per cent. sulphuric acid measured from a pipette.

Shake thoroughly and, as soon as the lead sulphate has settled, filter through a dry paper. Determine reducing matters by the Allihn method,‡ as follows: Mix 30 cc. of a solution containing 173 grams of Rochelle salts and 125 grams of caustic potash in 500 cc. of water, 30 cc. of solution of 34.69 grams of pure crystallized copper sulphate in 500 cc. of water, and 60 cc. of water, in a beaker of 300 cc. capacity, and heat to boiling. To the boiling liquid, without delay, add 25 cc. of the solution to be examined, heat to boiling, and boil two minutes. After the reduced copper suboxide has settled, collect on a Gooch crucible.

To prepare asbestos pulp for use in the Gooch crucible, cut woolly asbestos (best quality) into small pieces, boil with hydrochloric acid, and wash free from acid and fine particles on a sieve with 1 mm. meshes.

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* Chem. Centralbl., 1877, 8, 732.

† Prepared by boiling for 30 minutes, 430 grams of normal lead acetate and 130 grams of litharge with 1,000 cc. of water and diluting the filtrate to 1.25 sp. gr.

‡ Jour. prakt. Chem. 1880, N. F., 22, 52.

Woolly asbestos of suitable quality, when packed in the crucibles with the aid of a blunt glass rod, retains completely the finely divided copper suboxide, which is not true of the variety usually employed in filtering coarser precipitates.

The copper may be weighed either as Cu_2O, after washing successively with alcohol and ether, and drying at 100° C., or as CuO, after heating from two to five minutes at dull redness in the oxidizing flame.*

Owing to the high percentage of fat, the caking during washing with water, and the presence of cocoa red and other constituents, the determination of starch in cocoa products, whether by direct inversion or the much more exact diastase method, presents greater difficulties than are encountered in the analysis of most starchy materials.

The above described process, if strictly followed, gives results which, although not representing accurately the percentage of starch, are concordant and of considerable value in detecting starchy adulterants.

Pure Starch (*Diastase Method*). Treat 4 grams of the product if unsweetened or 10 grams if sweetened with ether and water, as described in the preceding section. Especial care should be exercised that the material is ground to a fine powder with ether.

Carefully wash the wet residue from the paper into a beaker with 100 cc. of water, heat on an asbestos plate to boiling with constant stirring, and continue the boiling and stirring thirty minutes. Replace the water lost by evaporation, and immerse the beaker in a water-bath kept at from 55° to 60°. When the liquid has cooled to the temperature of the bath, add 10 cc. of fresh extract of malt (prepared by digesting for two or three hours 100 grams of powdered fresh malt with 1,000 cc. of water and filtering), and digest the mixture for two hours with occasional stirring.† Boil a second time for thirty minutes, cool, and digest as before with another 10 cc. portion of malt extract. Heat to boiling the third time, cool, and transfer to a 250 cc. graduated flask. Add 3 cc. of alumina cream to insure a clear filtrate, make up to the mark, filter through a dry paper, and remove 200 cc. of the filtrate to a 500-cc. flask. Conduct the inversion, and determine the reducing power of the solution, as already described under "Copper-reducing matters by direct inversion," except that the treatment with basic acetate of lead and its removal with sulphuric acid is omitted. Make a correction for the dextrose due to the added malt extract, as determined by blank analyses. The residue after the malt digestion, when examined microscopically, must be entirely free from starch.

Owing to the high percentage of fat, it is impracticable to reduce cocoa nibs or chocolate to a powder finer than 1 mm., which is altogether too coarse for extracting the starch by the diastase method as well as for the determination of crude fiber. It is therefore necessary either to extract the fat from a weighed portion of the sample, dry the residue, weigh, grind to a fine powder and make the analysis on weighed portions of this fine fat-free material, or else grind weighed portions of the coarse material during the process of analysis as above described. The latter course is the more convenient of the two.

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* Maine Agr. Exp. Sta., 1888, 207.

† Handbuch der Spiritusfabrikation, 7th ed., 1898, 109; see also Wiley, Principles and Practice of Agricultural Analysis, 1897, vol. iii, 198.

As cocoa starch is said to be more resistant to boiling water than other starches, thorough boiling with water and a prolonged digestion with malt extract is advisable. Treatment with basic acetate of lead is not necessary.

Other Nitrogen-free Substances. These figures are obtained by subtracting from 100 the sum of the percentages of water, total ash, theobromin, caffein, other nitrogenous substances, crude fiber, pure starch and fat.

Fat. Weigh 2 grams of material into the inner tube of a Tollens, Johnson, or Wiley fat extractor. Keep in a sulphuric acid desiccator three days, or until the water is practically removed. Extract with anhydrous ether until no more fat is removed. Grind and repeat the extraction. Dry the extract at 100° C.

It is essential that the material be dried before extraction, but this drying cannot be performed to advantage by heat owing to the melting of the fat and consequent caking of the residue. A slight error is introduced if the air-dry material is extracted.

Total Nitrogen is determined by the Kjeldahl method.

Polarization (*Sugar*). Extract 13.024 grams of the material (half the normal quantity) on a filter paper with absolute ether, keeping the funnel covered with a watch glass to avoid absorption of water. Allow the residue to dry at the room temperature, and transfer, together with the paper, to a graduated 200-cc. flask. Add 60 cc. of water, shake and allow to stand with occasional shaking for three hours. Clarify with 10 cc. basic lead acetate, 2 cc. of a saturated solution of alum and 2 cc. of alumina cream. Make up to the mark, shake and filter through a dry paper. Polarize the solution in a 200 mm. tube before inversion and in a 220 mm. tube after inversion. Multiply the readings by four.

In the case of sweetened cocoa or chocolate, calculate the percentage of cane sugar by Clerget's formula, introducing a correction for the volume occupied by the insoluble matter determined as follows: After sufficient solution has been obtained for polarization, collect on the filter all the insoluble matter (undissolved substance, filter paper, lead and alumina precipitates, etc.) and wash several times with cold water. Wash into a dish with a jet of water, evaporate on a water bath to dryness and dry thoroughly at 120° C. Transfer the dry residue to a graduated 50 cc. flask, add water from a burette and heat rapidly to boiling in order to liberate air bubbles. If care is taken to stop the heating as soon as the boiling point is reached, no appreciable amount of water escapes as steam.

Finally, fill to the mark with water. The total number of cc. of water added is the corrected volume of the solution polarized.

Constants of the Fat. The melting point is determined on the ether extract by Wiley's method,* refractive index by the Zeiss butyro-refractometer,† or the Abbé refractometer with arrangement for heating, and iodine number by the Hübl process.‡

COFFEE.

BY A. L. WINTON.

Seventeen samples of whole coffee and 29 samples of ground coffee have been examined during the year. All the samples of whole coffee were found to be pure; 9 of the ground samples were variously adulterated.

Chicory was present in all the adulterated samples, and in two cases this was the only adulterant. In addition to chicory 6 of the samples contained imitation coffee consisting of broken lumps of a brown color made of wheat flour or middlings, and another contained pellets made of pea hulls and other ingredients.

The percentage of adulteration was greater than in preceding years, because especial care was taken to purchase samples suspected of adulteration.

Descriptions of the samples examined are given in Tables IX and X.

Messrs. Walker & Boell, proprietors of the Anchor Brand, No. 7902, state that they add chicory to this brand to secure the desired flavor and will change their labels to comply with the state law, with which they were previously unacquainted. They deny that any other things than coffee and chicory enter into the composition of this brand.

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* U. S. Dept. Agr., Bur. Chem., Bul. 65, 23.
† *Ibid.*, p. 23.
‡ *Ibid.*, p. 24.

Table IX.—Coffee not Found Adulterated.

Station No.	Brand.	Dealer.	Price per pound, cents.
	Unground Coffee.	*Bridgeport:*	
7912	Sold in bulk	Columbia Tea Co., 1214 Main st.	25
7913	Sold in bulk	Logan Bros., 1705 Main st.	25
7915	Putnam Park Java and Mocha, The Elbridge Gerry Co., Danbury	*Danbury:* R. E. Church, 147 Main st.	25
7919	Gold Star Blend, Mocha and Java, Berry-Hall Co., New York	G. H. Vermilyea, 62 Elm st.	35
		Hartford:	
7906	Wonder Mocha and Java, L. Brayton & Co., Boston	Joe Malby, 137 Front st.	25
		Middletown:	
10388	Mocha and Java, Bacon Stickney & Co., Albany, N. Y.	W. K. Spencer, 96 Main st.	28
		New Haven:	
7899	Sold in bulk	S. S. Adams, 745 Grand ave.	15
7894	Mocha and Java, J. O. Clogston & Sons	J. O. Clogston & Sons, 27 Dixwell ave.	25
7898	Sold in bulk	W.C. Dingwall, 66 Congress ave.	25
7897	Merry War, J. H. Pierce & Co., Boston	G. F. Gerner, 858 State st.	25
7892	Oriental Java and Mocha, Seyms & Co., Hartford	John P. Hugo, 92 Nicoll st.	25
		New London:	
10381	Sold in bulk	Grand Union Tea Co., State st.	25
10380	Sold in bulk	A. M. Stacy, 123 State st.	25
		Norwalk:	
7901	Country Club, Holmes, Keeler & Selleck Co., Norwalk, Conn.	Raymond, Grocer, Main st.	25
		Waterbury:	
10375	Sold in bulk	T. J. Doran, 455 E. Main st.	25
10376	Loyal Blend, Mocha and Java, Miner, Read & Garrette, New Haven	W. H. Fudge, 446 So. Main st.	25
		Willimantic:	
10386	Sold in bulk	Public Market, 901 Main st.	25
	Ground Coffee.	*Bridgeport:*	
7907	Golden Brand Blended, David Trubce & Co., Bridgeport	New York Grocery, 857 Kossuth st.	25
7909	Commonwealth, J. F. Nickerson Co., Boston	Public Market, 114 State st.	25
7908	Our Gold Coin, Java and Mocha Flavor, Rose & Wills	Rose & Wills, 1894 Main st.	25
		Danbury:	
7914	Victor, Shapleigh Coffee Co., Boston	M. McPhelemy, 44 White st.	25

TABLE IX.—COFFEE NOT FOUND ADULTERATED.—*Continued.*

Station No.	Brand.	Dealer.	Price per pound, cents.
		Hartford:	
7903	Autocrat Java, Brownell & Field Co., Providence, R. I.	Allen Bros., 466 Main st.	25
7905	Colonial Blend, Seyms & Co., Hartford	C. N. Dodge, 338 Main st.	35
7904	Victoria Java and Mocha, Browning & Baines, New York, Phila. and Wash.	S. Vogel, 361 Main st.	35
		New Britain:	
10377	Monarch Java, Fraser Bros. Co., Prov., R. I.	City Market, 319 Main st.	25
		New Haven:	
7896	Blue Label Java and Mocha, Seyms & Co., Hartford	The Three G's, 23–27 Edwards st.	25
7895	Boardman's Gold Star Mocha and Java, The Wm. Boardman & Sons Co., Hartford	E. Schonberger & Son, George st.	25
7893	Capitol Mills Java and Mocha, Chas. G. Lincoln & Co., Hartford	J. J. Sullivan, Nash and Eagle sts.	25
		New London:	
10379	Helmet Brand Java and Mocha, E. S. Kibbe Co., Hartford	J. M. Chapin, Jr., Huntington and Washington sts.	35
10378	Sold in bulk	Thos. R. Kehr, 265 Bank st.	25
		Norwich:	
10382	Mocha and Java, H. D. Avery	H. D. Avery, 202 Franklin st.	25
10385	Silver Edge Java, The L. A. Gallup Co., Norwich	A. Francis & Son, Thames and W. Main sts.	25
10384	Regal Java and Mocha, The E. S. Kibbe Co., Hartford	Gus. Thumm, 71 Franklin st.	25
10383	Gilt Edge Mocha and Java, The L. A. Gallup Co., Norwich	E. Tracy, 127 W. Main st.	30
		Waterbury:	
7922	The Golden Star, The F. C. Bushnell Co., New Haven and Waterbury	Fruin's Grocery, 465 W. Main st.	25
7923	Hermitage, Stoddard, Gilbert & Co., New Haven	Willis C. Hall, 11 Cherry st.	25
		Willimantic:	
10387	Star Java, Brownell & Field Co., Prov., R. I.	Milton Hall, 17 Union st.	35

TABLE X.—ADULTERATED COFFEE.

Station No.	Brand.	Dealer.	Price per pound, cents.	Adulterants.
7911	Sold in bulk	*Bridgeport:* Ford & Jones, 1362 Main st.	10	Chicory; imitation coffee.†
7910	Sold in bulk	Village Store Co., 1624 Main st.	25	Chicory.
7918	Sold in bulk	*Danbury:* Atlantic and Pacific Tea Co., 163 Main st.	25	Chicory; imitation coffee.†
7917	Sold in bulk	Danbury Grocery Co., Main st.	25	Chicory.
7916	Sold in bulk	Village Store Co., 236 Main st.	25	Chicory; imitation coffee.†
7902	Anchor Brand, Walker & Boell, New York*	*So. Norwalk:* The Central Food Co., W. Washington st. and R. R. ave.	15	Chicory; imitation coffee.†
7900	Sold in bulk	*Stamford:* Empire State Tea Co., 303 Main st.	25	Chicory; imitation coffee.†
7921	Sold in bulk	*Waterbury:* New York and China Tea Co., 181 So. Main st.	25	Chicory; pellets.‡
7920	Sold in bulk	J. F. Phelan, 42 E. Main st.	25	Chicory; imitation coffee; † pellets.‡

* See statement on page 145.

† Brown lumps made from some wheat product resembling ground roasted coffee.

‡ Made of pea hulls and other materials.

LARD.

By A. L. Winton and A. W. Ogden.

Compound lard is a mixture of cotton seed oil with enough stearin to give it the requisite degree of solidity and a small amount of real lard. Lard stearin, the residue left after expressing lard oil, cotton seed stearin, obtained by a similar process in the manufacture of "Winter" cotton seed oil, or, rarely, paraffine, may be used in place of beef stearin.

Although compound lard is made according to different formulas to meet the requirements of different markets, the product almost invariably contains more cotton seed oil than all the other ingredients taken together. Real lard is a minor constituent.

The sale of compound lard for lard is a fraud akin to the sale of oleomargarine for butter. Even if the product is designed merely as a substitute for lard and is sold at wholesale under its true name, when retailed as lard it is, under the law, an adulterated food product.

Examination of Samples.

Of 134 samples from the Connecticut market examined during the past year, 4 were sold as compound lard, the remaining 130 as lard. Sixty-three of the samples sold as lard, or 48.8 per cent., were mixtures containing large amounts of cotton seed oil and consequently were grossly adulterated.

Descriptions of the samples are given in Tables XI, XII and XIII.

Both the number of adulterated samples and the percentage of adulteration were greater during the past year than during any of the four years when examinations of this product have been made at this Station. This is due partly to the present high price of lard, and partly to the experience of our agent which enables him often to detect the adulterated product by its appearance alone.

A summary of the results obtained in the examination of samples sold as lard during the years 1896, 1900, 1902, and 1903, together with the average prices per pound, follows:

	1896.	1900.	1902.	1903.
Number of samples not found adulterated	75	150	111	67
Number of samples adulterated	43	10	55	63
Total	118	160	166	130
Per cent. of samples adulterated	36.5	62.2	33.1	48.8
Average price per pound of samples not found adulterated (cents)	11.2	10.0	14.2	13.8
Average price per pound of samples found adulterated (cents)	9.4	8.4	11.5	11.1

Methods of Examination.[*] Refractive index was determined at 40° C. in the Zeiss butyro-refractometer and specific gravity at 98° C. by a Westphal balance. Cotton seed oil was detected by the Halphen test,[†] and the Bechi test as modified by Dudley.[‡] Tests for beef stearin were made by the Gladding-Belfield tests,[§] and for paraffine by the usual saponification method.

Range in Composition. In the samples examined the physical constants varied as follows:

	Refractometer reading at 40°.	Refractive index at 40°.	Specific Gravity at 98° C. (Water at 15.5° = 1).
Lard not found adulterated	50–51.	1.4593–1.4600	
Adulterated Lard	54–56.5	1.4619–1.4636	0.8635–0.8656
Compound Lard	55–57.	1.4626–1.4639	0.8648–0.8655

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[*] For a detailed description of these methods see Report for 1900, 138, also U. S. Dept. Agr., Bur. Chem. 65, 20.

[†] Jour. Pharm. Chim., 1897, 6, 390.

[‡] Jour. Am. Chem. Soc., 1895, 17, 724.

[§] *Ibid.*, 1896, 18, 189.

TABLE XI.—LARD NOT FOUND ADULTERATED.

Station No.	Brand.	Dealer.	Price per pound, cents.
		Bridgeport:	
10338	Sold in bulk	C. K. Bishop, 653 E. Washington ave.	14
10329	" " "	The Coe & White Co., 1252 Main st.	14
10328	" " "	Ford & Jones, 1362 Main st.	14
10341	" " "	N. Y. Grocery, 857 Kossuth st.	14
10327	" " "	Roger Farm Dairy, 266 State st.	14
10325	" " "	G. C. Stewart, 198 Fairfield ave.	14
10335	" " "	Village Store Co., 1624 Main st.	12
10339	" " "	W. L. Wolfram, E. Main and Maple sts.	15
		Danbury:	
10352	Sold in bulk	Atlantic and Pacific Tea Co., 163 Main st.	14
10344	" " "	C. Beers, 101 White st.	14
10347	" " "	Danbury Grocery Co., Main st.	12
10349	" " "	Ehle's Cash Grocery, 5 West st.	14
10348	" " "	Village Store Co., 236 Main st.	12
		Hartford:	
7867	Sold in bulk	City Hall Grocery, 42 State st.	13
7868	" " "	C. N. Dodge, 338 Main st.	14
10437	" " "	Geo. F. Kellogg, 125 Ann st.	14
10438	" " "	Geo. C. McLean, 16 Maple st.	14
7870	" " "	A. H. Tillinghast, 341 Main st.	14
10439	" " "	W. J. Tolhurst & Son, 53 Maple ave.	15
		Middletown:	
10465	Sold in bulk	Briggs & Walker, 136 Main st.	15
10466	" " "	W. K. Spencer, 96 Main st.	14
		New Britain:	
10435	Sold in bulk	City Market, 319 Main st.	12
10432	" " "	H. A. Hall, 212 Main st.	14
10427	" " "	Thos. McCabe, 591 Main st.	15
10434	" " "	Sidney Oldershaw, 262 Park st.	14
10428	" " "	C. M. Oquist, 239 Elm st.	14
10431	" " "	W. H. Pierce & Son, 72 W. Main st.	15
		New Haven:	
7829	Sold in bulk	Booth Meat Co., 80 Congress ave.	14
7836	" " "	C F. Curtiss, State and Bishop sts.	14
7837	" " "	The Three G's, 23 Edwards st.	14
7839	" " "	F. J. Markle, 105 Broadway	12
7840	Morrell's Pure, John Morrell & Co., Ottumwa, Iowa	Mohican Co., 22 Church st.	13
7831	Sold in bulk	Pohlman & Scanlon, 140 Dixwell ave.	14
7833	" " "	E. Schonberger & Sons, George st.	12
7824	" " "	M. H. Sheridan, 67 Nicoll st.	14

TABLE XI.—LARD NOT FOUND ADULTERATED.—*Continued.*

Station No.	Brand.	Dealer.	Price per pound, cents.
		New London:	
10441	Sold in bulk	J. R. Avery & Son, 19 Broad st.	14
10449	" " "	G. M. Chapin, Jr., Huntington and Washington sts.	14
10443	" " "	M. Wilson Dart, 486 Bank st.	14
10447	" " "	Thos. J. Kehr, 265 Bank st.	14
10445	" " "	Thos. R. Murray, 4 Truman st.	15
10444	" " "	W. A. Murray, 729 Bank st.	14
10440	" " "	Frank H. Smith, 100 State st.	14
10448	" " "	Geo. H. Thomas, 437 Bank st.	14
		Norwalk:	
7850	Sold in bulk	Thos. H. Burns, Wall st.	15
7853	" " "	Raymond, Grocer, Main st.	14
		Norwich:	
10453	Sold in bulk	Appley & Jordon, 88 W. Main st.	14
10451	" " "	Joseph Connors & Sons, 68 Water st.	14
10454	" " "	A. Francis & Son, Thames and W. Main st.	14
10452	" " "	John S. Spicer, 116 Water st.	12
10450	" " "	E. Tracy, 127 W. Main st.	14
10455	" " "	Thos. Wilson, 78 Franklin st.	14
		So. Norwalk:	
7858	Sold in bulk	The Central Food Co., W. Washington and Railroad ave.	14
7855	" " "	F. D. Lawton, 22 So. Main st.	14
7857	" " "	Edwin Wilcox, 70 Washington st.	14
7861	" " "	..............., 5 Monroe st.	14
		Stamford:	
7844	Sold in bulk	G. A. Ferris, 446 Main st.	14
7842	" " "	P. Hanrahan, 29 Pacific st.	14
7841	" " "	Kirk & Dixon, 129 Atlantic st.	15
7849	Shield Brand Leaf, Armour & Co.	N. Y. Provision Co., 240 Atlantic st.	40*
7847	Sold in bulk	C. M. Slater, 282 Main st.	15
		Waterbury:	
10358	Sold in bulk	Blanchett's Grocery, 258 So. Main st.	15
10353	" " "	Willis C. Hall, 11 Cherry st.	15
10357	" " "	F. Kilmartin, 495 W. Main st.	14
		Willimantic:	
10463	Sold in bulk	D. F. Blish & Son, 66 Church st.	14
10461	" " "	Milton Hall, 17 Union st.	14
10462	" " "	C. R. Hibbard, 22 North st.	12
10459	Morrell's Pure, John Morrell & Co., Ottumwa, Iowa	Public Market, 901 Main st.	14

* Per 3 lb. pail.

TABLE XII.—ADULTERATED LARD.

Station No.	Brand.	Dealer.	Price per pound, cents.
		Bridgeport:	
10340	Sold in bulk	Atlantic & Pacific Tea Co., 707 E. Main st.	10
10336	" " "	L. Brown, 723 Pembroke st.	10
10333	" " "	Centennial Tea Co., 1688 Main st.	10
10326	" " "	H. Isenberg & Co., 109 State st.	14
10334	" " "	Logan Bros., 1705 Main st.	10
10337	" " "	Palace Market, 558 E. Main st.	10
10330	" " "	Public Market, 114 State st.	10
10332	" " "	N. Shapiro, 260 No. Washington ave.	10
		Danbury:	
10351	Sold in bulk	R. E. Church, 147 Main st.	14
10350	" " "	Doran's Cash Grocery, 148 Main st.	12
10342	" " "	M. McPhelemy, 44 White st.	10
10343	" " "	N. Y. Cash Grocery, 307 Main st.	10
10345	" " "	People's Cash Market, 89 White st.	10
10346	" " "	G. H. Vermilyea, 62 Elm st.	12
		Hartford:	
7862	Sold in bulk	Allen Bros., 466 Main st.	12
7866	" " "	Citizen Grocery & Provision Co., 267 Main st.	10
7871	" " "	Dow & Hatch, 2 Church st.	10
7864	" " "	John Hludike, 84 Temple st.	12
7863	" " "	P. S. Kennedy, 1040 Main st.	10
10436	" " "	C. H. Strong, 131 Main st.	14
7865	" " "	Union Grocery, 1026 Main st.	10
7869	" " "	S. Vogel, 361 Main st.	14
		Middletown:	
10464	Sold in bulk	A. M. Bidwell, 348 Main st.	12
10469	" " "	D. J. Hartman, 530 Main st.	12
10468	" " "	Middletown Cash Grocery, 354 Main st.	10
10467	" " "	York State Butter House, 262 Main st.	12
		New Britain:	
10429	Sold in bulk	A. Bonander, 22 Park st.	12
10430	" " "	J. E. Murphy, 500 Main st.	12
10425	" " "	Public Market, 375 Main st.	13
		New Haven:	
7835	Sold in bulk	S. S. Adams, 745 Grand ave.	10
7834	" " "	A. Basserman, 209 Grand ave.	10
7827	" " "	M. C. Dingwall, 66 Congress ave.	10
7832	" " "	Logan Bros., 341 Grand ave.	10
7830	" " "	New Haven Provision Co., 384 Grand ave.	10
7826	" " "	Union Supply Co., 442 State st.	12
7838	" " "	W. E. Waterbury, 774 State st.	12

TABLE XII.—ADULTERATED LARD—*Continued.*

Station No.	Brand.	Dealer.	Price per pound, cents.
		New London:	
10442	Sold in bulk	Mohican Co., 261 State st.	10
10446	" " "	New York Cash Grocery, 179 Bank st.	10
		Norwalk:	
7851	Sold in bulk	Finney & Benedict, 41 Wall st.	12
7854	" " "	Grand Central Grocery, 19 Main st.	10
7852	" " "	N. Y. Grocery, 35 Main st.	10
		Norwich:	
10457	Sold in bulk	Aldrich & McNickle, 36 Franklin st.	14
10458	" " "	H. D. Avery, 202 Franklin st.	12
10456	" " "	People's Market, 6 Franklin st.	14
		South Norwalk:	
7860	Sold in bulk	D. S. Davenport, 22 No. Washington st.	10
7856	" " "	Lorenzo Dibble, 13 No. Washington st.	10
7859	" " "	N. Y. Grocery, 118 Washington st.	10
		Stamford:	
7845	Sold in bulk	C. Anderson & Co., 492 Main st.	10
7846	" " "	O. S. Brown, 10 Park Row	10
7848	" " "	Empire State Tea Co, 303 Main st.	10
7843	" " "	R. T. Woodbury, 107 Pacific st.	10
		Waterbury.	
10355	Sold in bulk	Chas. Boylan, 194 So. Main st.	10
10366	" " "	Brownell's Boston Butter House, 147 S. Main st.	10
10362	" " "	Chas. Dahrouge, 336 So. Main st.	10
10365	" " "	T. J. Doran, 455 E. Main st.	12
10359	" " "	Foote's Cash Grocery, 480 W. Main st.	10
10354	" " "	Fruin's Grocery, 465 W. Main st.	14
10363	" " "	W. H. Fudge, 446 So. Main st.	12
10364	" " "	McCarthy Cash Grocery, 671 E. Main st.	14
10356	" " "	Public Market, 161 So. Main st.	12
10361	" " "	John Tato, 354 W. Main st.	12
10360	" " "	Whalen's Cash Grocery, Junction Broadway	10
		Willimantic:	
10460	Sold in bulk	City Grocery Store, 877 Main st.	10

TABLE XIII.—COMPOUND LARD.

Station No.	Brand.	Dealer.	Price per pound, cents.
		Bridgeport:	
10331	Sold in bulk	Rose & Wills, 1894 Main st.	10
		New Britain:	
10426	Sold in bulk	East End Market, Hartford ave. and Spring st.	12
10433	" " "	Wm. Foulds, 226 Park st.	12
		New Haven:	
7825	Sold in bulk	S. S. Adams, 406 State st.	10

MISCELLANEOUS SAMPLES SENT BY PRIVATE INDIVIDUALS.

Milk. Determination of fat, tests for preservatives and in some cases determinations of total solids have been made in 19 samples of milk sent by milkmen and consumers. The average percentage of fat in these samples was 4.16. None contained either boric acid or formaldehyde.

Cream. Four samples contained respectively 16.0, 18.0, 34.8 and 47.8 per cent. of fat. One was preserved with formaldehyde.

10549. *Baking Powder,* sent by E. D. Sheldon, Pine Orchard. A phosphate powder, containing no alum.

10254. *Vinegar,* sent by W. J. Andrews, Cheshire. Acidity 4.28; solids 1.29 per cent.

10253. *Vinegar,* sent by W. J. Andrews, Cheshire. Acidity 2.35; solids 2.06 per cent.

10095. *Porto Rico Molasses,* sent by S. S. Adams, New Haven. Not found adulterated.

10246. *Butter,* sent by J. D. Hammond, New Haven. Not found adulterated.

10066. *Randall's Grape Juice,* put up by Chautauqua Fruit Co., Ripley, New York, sent by Howe & Stetson, New Haven. Contained neither salicylic nor benzoic acids.

9986. *Dextrosed wheat,* sent by Ephraim Cutter, M.D., New York City. A cereal product containing a considerable amount of sugars formed from starch.

FOOD PRODUCTS EXAMINED FOR THE DAIRY COMMISSIONER IN THE TWELVE MONTHS ENDING JULY 31, 1903.

The following samples were referred to this Station for examination by the Dairy Commissioner:

SUSPECTED BUTTER.

Five samples were examined. All of them were genuine butter free from admixture with oleomargarine.

MOLASSES.

Four hundred and fourteen samples were examined of which fifteen were adulterated by mixture of glucose.

VINEGAR.

Four hundred and sixty-three samples were examined. Of this number, eighty-three contained less than 4 per cent. of acidity reckoned as acetic acid, which is the minimum limit prescribed by law.

SUMMARY.

In Table XIV are given the kind and number of food products examined by the Station within the year covered by this report, the number of each kind not found adulterated, the number adulterated and the number marked "compound."

From this it appears that of the 1139 samples examined, 11 were "compounds" and 183, or 16 per cent., were variously adulterated.

TABLE XIV.—SUMMARY OF THE RESULTS OF EXAMINATION OF FOOD PRODUCTS IN 1903.

	Not found adulterated.	Adulterated or below standard.	Compounds.	Total number examined.
Sampled by Station:				
Chocolate, plain	7	8	5	20
Chocolate, sweet	15	3	2	20
Pepper	7	--	--	7
Coffee, whole	17	--	--	17
Coffee, ground	20	9	--	29
Lard	67	63	4	134
Sampled by individuals:				
Milk	19	--	--	19
Cream	3	1	--	4
Baking powder	1	--	--	1
Vinegar	1	1	--	2
Molasses	1	--	--	1
Butter	1	--	--	1
Grape juice	1	--	--	1
Dextrosed wheat	1	--	--	1
Sampled by Dairy Commissioner:				
Butter	5	--	--	5
Molasses	399	15	--	414
Vinegar	380	83	--	463
	945	183	11	1139

THE COMPOSITION OF ACHEEN AND LAMPONG BLACK PEPPER.

BY A. L. WINTON AND E. MONROE BAILEY.

At a conference of spice grinders and official agricultural chemists held in New York City in the summer of 1903, the spice grinders stated that 6.50 per cent. of ash, the maximum amount provisionally adopted by the Committee on Standards of the Association of Official Agricultural Chemists, although higher than is allowed in some European countries, was too low to admit much of the Acheen and Lampong black pepper now on the market in the United States.

Both of these varieties are sun-dried on the ground and are contaminated with a certain amount of small stones, lumps of clay, adhering dirt and other impurities which cannot be readily separated.

Lampong pepper is grown in the southeastern end of the island of Sumatra; Acheen pepper, a lower grade, also known as Penang pepper, from the port of shipment, is grown in the northwestern end of the same island. The designations "East Coast" and "West Coast," formerly applied to pepper from Sumatra, are now little used.

Acheen pepper is now graded by the General Produce Association of London according to the following rules, which are printed on each arrival contract:

"1. The following to be the standards of quality:

Class A—Heavy	weighing	4 lbs.	13 ozs.	per gal. measure.	Dust 3%
B—Fair	"	4 lbs.	5 ozs.	" "	
C—Fair Merchantable	"	3 lbs.	13 ozs.	" "	
D—Light	"	3 lbs.	5 ozs.	" "	

2. The term dust to include stalks, stones, clay, and other foreign matter.

3. For the purpose of ascertaining the proportion of dust five per cent. of each mark shall, in the first instance, be sifted through a No. 9½ sieve, in galvanized iron with round holes (one of which is held by the General Produce Brokers' Association). Of the sifted pepper fifty pounds of each mark shall be hand-picked free from stalks, stones, clay, and other foreign matter, and the percentage of impurities so found shall be added to the percentage of dust as ascertained by sifting. These operations to be performed by one of the customary docks or wharves.

4. Should the pepper be found to contain more than 3 per cent. of dust, any excess up to 2 per cent. shall be treated as valueless, and allowed

to the buyer. Should the additional 2 per cent. be exceeded, the buyer shall have the option of taking the pepper with an allowance for any dust in excess of 3 per cent., or of invoicing back the parcel to the seller at the fair market value of the day of the quality contracted for, plus a fine of not less than 2 per cent., and not more than 10 per cent., the value and fine to be fixed by arbitration in the usual manner. Any fraction below half per cent. to be neglected, any greater fraction to carry the next higher integral.

5. For the purpose of ascertaining the weight of a parcel, the average sample taken by the dock company or wharfingers shall first be freed from dust and other impurities, and then filled into a gallon measure, shaken down as closely as possible without pressure, and struck off and weighed, the average of three fillings to be taken for twenty-five tons or less. This operation to be performed by the selling brokers, who shall state the separate weights of the three tests on the out-turn accounts.

6. In the event of seller or buyer being dissatisfied with the return of the weighing by the selling brokers, either of them shall have the option, within a week from the date of the first selling broker's return, of calling for a fresh average sample to be drawn, and the matter shall be referred to arbitration. The arbitrators to test both the landing and re-drawn samples, and the testings to be averaged, and the result to be considered final. Should the pepper have been re-shipped before a fresh sample is asked for, the first weighing shall be taken as final.

7. Should the pepper be found to weigh less than the minimum of the class named, the buyer shall take the same with an allowance of *one-quarter per cent.* on the sale price for the first ounce or fraction of an ounce, and a *further one-half per cent.* for the second ounce or fraction over an ounce, but should the deficiency in weight exceed *two ounces,* the pepper to be invoiced back to the seller at the fair market value of the day, of the quality contracted for, plus a fine of not less than 2 per cent. and not more than 10 per cent., the value and fine to be fixed by arbitration in the usual manner.

8. Samples to be drawn of not less than twenty-eight pounds for parcels of twenty-five tons or less. In case a second sample be required, half of the total quantity drawn to be returned to the bulk."

Acheen pepper of all classes is said to be sifted free of loose shells before shipment, but it contains light weight and empty kernels which are more or less broken up during the sea voyage and handling, and as a consequence the consignments when they reach this country are invariably contaminated with a considerable amount of dust consisting largely of pepper shells. As the allowance of 3 per cent. is deemed sufficient to cover the dust formed in this way, any excess over that amount may be considered as due to imperfect sifting before shipment.

According to the statements of leading importers, about one-fifth of the black pepper consumed in the United States is C

Acheen, and if the standards of composition are so adjusted as to exclude this variety the price of pepper to the consumer will be materially increased. Although of a decidedly poor quality, classes A, B and C are believed by many to be legitimate articles of commerce. They have been compared to coarse, dark flour, meat of old animals and other inferior but harmless products on which the poorer people are often obliged to depend for daily food.

ANALYSES OF SAMPLES.

Richardson, in 1887, analyzed four samples of Acheen (West Coast) pepper; Winton, Ogden and Mitchell in 1898, two samples of Lampong and five of Acheen; Doolittle in the present year, eight of Lampong and eight of Acheen. All of these samples were of whole pepper and the methods employed by all the analysts, were for the most part the same.

The samples analyzed by Winton, Ogden and Mitchell were taken in each case by a representative of the Station from several original packages in warehouses of importers, but they were necessarily small, weighing at the most but a few pounds. Those examined by Doolittle were in a number of cases taken after grinding a whole bag, thus securing an especially accurate sample of lots containing a considerable amount of loose dirt or hulls. This work of sampling was not, however, done by the chemist nor in his presence.

In order to secure further evidence with regard to these grades of pepper as now found on the market and especially as to the amount of ash, it was decided to accept the generous offer of coöperation made by Messrs. E. R. Durkee & Co., New York, The A. Colburn Co., Philadelphia, and The Stickney & Poor Spice Co., Boston, three of the largest spice houses in the country, who agreed to furnish the pepper, the use of their mills and other facilities necessary for securing representative samples.

In carrying out this plan one of us (Mr. Winton) visited the mills of each of the houses named and superintended the sampling. Three bags of each lot weighing about 300 pounds were selected by him at random from the warehouse and ground in his presence.*

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* In the case of No. 10,732, only one bag was taken.

The pepper was weighed before and after grinding and nothing was rejected except an inconsiderable amount of rope, wood, etc., weighing in no case more than one pound and usually much less. In every instance the weight after grinding was slightly less than before, due to loss of dust and moisture. The greatest loss was 3 per cent., but in the other cases was much less.

Duplicate samples of each lot were drawn and sealed, one being left with the grinder, the other taken to the Station laboratory and analyzed. Samples of whole pepper were also taken to illustrate the general appearance of the products and are now preserved at the Station for future reference.

Analyses were made by the methods employed at this Station in 1898* and since provisionally adopted by the Association of Official Agricultural Chemists.† Results of these analyses are given in Table XV and a compilation of all available American analyses of Lampong and Acheen pepper in Table XVI.

The percentages of ash and sand were obtained prior to a recent meeting of the Committee on Food Standards of the Association of Official Agricultural Chemists, and by vote of this committee the standard of 7 per cent. ash was finally adopted. As defined by this committee and finally proclaimed and established by the Secretary of Agriculture, *Standard black pepper* is black pepper free from added pepper shells, pepper dust, and other pepper by-products and containing not less than six (6) per cent. of nonvolatile ether extract; not less than twenty-two (22) per cent. of starch by the diastase method; not less than twenty-eight (28) per cent. of starch by direct inversion,‡ not more than seven (7) per cent. of total ash; not more than two (2) per cent. of ash insoluble in hydrochloric acid, and not more than fifteen (15) per cent. of crude fiber. One hundred parts of the nonvolatile ether extract contain not less than three and one-quarter (3.25) parts of nitrogen.

The limits of ash, sand and crude fiber allowed by these standards are the same as are in force in Germany.§

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* Conn. Agr. Exp. Sta., Rep. 1898, pp. 186-191.

† U. S. Dept. Agr., Bur. Chem., Bul. 65, pp. 55-62.

‡ Copper-reducing matters by direct inversion calculated as starch.

§ Vereinbarungen zur einheitlichen Untersuchung und Beurtheilung von Nahrungs- und Genussmitteln sowie Gebrauchsgegenständen für das Deutsche Reich. Heft II, 1899, pp. 62-65.

TABLE XV.—ANALYSES OF LAMPONG AND ACHEEN BLACK PEPPER.

Station No.	Grade.	Importer.	Moisture.	Ash.			Ether extract.		Alcohol extract.	Reducing matters by direct inversion calculated as starch.	Starch by diastase method.	Crude fiber.	Total N. less N. in non-volatile ether extract, x 6¼.	Nitrogen.		Parts of N. in 100 parts non-volatile ether extract.
				Total.	Soluble in water.	Insoluble in HCl.	Volatile.	Non-volatile.						Total.	In non-volatile ether extract.	
10734	Lampong	The A. Colburn Co., Phila.	11.79	5.96	2.67	1.03	1.34	9.00	9.89	39.64	33.84	13.08	10.81	2.07	0.34	3.56
10732	"	E. R. Durkee & Co., New York	11.25	6.85	2.45	1.63	1.18	7.58	8.31	40.63	35.47	12.10	10.94	2.06	0.31	3.90
10735	Acheen, Class B	The A. Colburn Co., Phila.	11.77	5.81	2.69	1.25	1.75	8.24	9.05	36.67	30.79	15.85	11.81	2.23	0.34	3.88
10729	" "	E. R. Durkee & Co., New York	12.51	5.00	2.99	0.83	1.57	8.49	9.07	38.25	32.65	14.45	11.81	2.24	0.35	3.90
10733	Acheen, Class C	The A. Colburn Co., Phila.	12.11	5.40	2.81	0.88	1.48	8.52	8.90	35.55	28.60	16.56	12.06	2.30	0.37	4.06
10730	" "	E. R. Durkee & Co., New York	11.81	6.26	3.15	1.26	1.64	9.24	9.89	32.98	26.40	17.05	12.31	2.34	0.37	3.82
10746	" "	Stickney & Poor, Boston	10.84	5.83	3.06	1.09	2.20	9.59	10.63	31.77	24.94	17.70	12.44	2.38	0.39	3.72

TABLE XVI.—COMPILATION OF AMERICAN ANALYSES OF LAMPONG AND ACHEEN BLACK PEPPER.

Grade.	Importer.	Analyst.	Year.	Weight of 100 corns in grams.	Moisture.	Ash.			Ether extract.		Alcohol extract.	Reducing matters by direct inversion calculated as starch.	Starch by diastase method.	Crude fiber.	Total N less N. in non-volatile ether extract, x 6¼.	Nitrogen.		Parts of N. in 100 parts non-volatile ether extract.
						Total.	Soluble in water.	Insoluble in HCl.	Volatile.	Non-volatile.						Total.	In non-volatile ether extract.	
Lampong....	E. R. Durkee & Co., N. Y.	Winton, Ogden, and Mitchell*	1898	3.43	10.63	6.52	2.16	1.19	1.11	8.67	9.49	37.09	33.41	12.72	11.37	2.15	0.33	3.82
"	Francis H. Leggett & Co., New York	" "	"	3.55	12.17	4.86	2.21	0.48	1.23	9.05	9.95	41.42	37.59	11.57	10.50	2.03	0.35	3.85
"	E. B. Miller & Co., Chicago	Doolittle†	1903	3.79	8.28	5.04	1.97	1.07	2.10	8.19	....	....	36.48	12.60	11.62	2.20	0.34	4.27
"	Durand & Kasper Co., Chicago	"	"	3.48	8.09	6.27	1.81	1.40	1.44	8.09	...	....	35.52	13.50	10.50	2.03	0.35	4.17
"	Franklin, MacVeagh & Co., Chicago	"	"	3.71	10.48	4.93	2.03	0.75	1.88	8.51	....	....	38.92	11.99	11.00	2.10	0.34	4.17
"	Austin, Nichols & Co., N. Y.	"	"	3.32	8.99	5.47	2.57	0.57	1.59	6.81	....	...	39.15	10.40	10.50	2.00	0.32	4.24
"	Francis H. Leggett & Co., New York	"	"	3.41	11.96	5.21	1.86	0.88	1.49	8.07	...	....	35.86	13.16	11.00	2.11	0.35	4.12
"	Bennett, Simpson & Co., New York	"	"	3.36	9.17	5.01	1.71	0.74	1.83	7.33	....	....	39.51	10.25	10.11	2.00	0.35	4.27
"	E. R. Durkee & Co., N. Y.	"	"	3.61	9.15	6.39	1.65	1.62	1.22	8.25	....	....	39.46	11.73	11.00	2.11	0.35	4.12
"	E. R. Durkee & Co., N. Y.	"	"	....	9.18	6.45	1.76	1.80	1.22	7.97	....	....	39.27	11.94	10.19	1.97	0.34	4.08
"	The A. Colburn Co., Phila.	Winton & Bailey‡	"	3.69	11.79	5.96	2.67	1.03	1.34	9.00	9.89	39.64	33.84	13.08	10.81	2.07	0.34	3.56
"	E. R. Durkee & Co., N. Y.	" "	"	3.72	11.25	6.85	2.45	1.63	1.18	7.58	8.31	40.63	35.47	12.10	10.94	2.06	0.31	3.90
	Maximum		....	3.79	12.17	6.85	2.67	1.80	2.10	9.05	9.95	41.42	39.51	13.50	11.62	2.20	0.35	4.27
	Minimum		....	3.32	8.09	4.86	1.65	0.48	1.11	6.81	8.31	37.09	33.41	10.25	10.19	1.97	0.31	3.56
	Average		....	**3.55**	**10.10**	**5.75**	**2.07**	**1.10**	**1.47**	**8.13**	**9.41**	**39.69**	**37.04**	**12.09**	**10.79**	**2.07**	**0.34**	**4.05**
Acheen "A"	E. R. Durkee & Co., N. Y.	Winton, Ogden, and Mitchell*	1898	**3.44**	**12.09**	**5.04**	**2.78**	**0.48**	**1.09**	**9.17**	**10.04**	**38.17**	**33.30**	**13.07**	**10.88**	**2.11**	**0.37**	**4.06**
Acheen "B"	E. R. Durkee & Co., N. Y.	Winton, Ogden, and Mitchell*	"	2.66	12.95	6.15	3.04	1.15	1.15	9.03	9.95	36.40	33.08	14.09	11.75	2.25	0.37	4.06
" "	The A. Colburn Co., Phila.	Winton & Bailey ‡	1903	3.51	11.77	5.81	2.69	1.25	1.75	8.24	9.05	36.67	30.79	15.85	11.81	2.23	0.34	3.88
" "	E. R. Durkee & Co., N. Y.	" "	"	3.90	12.51	5.00	2.99	0.83	1.57	8.49	9.07	38.25	32.65	14.45	11.81	2.24	0.35	3.90
	Maximum		....	3.90	12.95	6.15	3.04	1.25	1.75	9.03	9.95	38.25	33.08	15.85	11.81	2.25	0.37	4.06
	Minimum		....	2.66	11.77	5.00	2.69	0.83	1.15	8.24	9.05	36.40	30.79	14.09	11.75	2.23	0.34	3.88
	Average		....	**3.35**	**12.41**	**5.65**	**2.91**	**1.08**	**1.49**	**8.59**	**9.36**	**37.11**	**32.17**	**14.80**	**11.79**	**2.24**	**0.35**	**3.95**

* Report of this Station, 1898, 199.

† Mich. Dairy and Food Dep't., Bull. 94, 8.

‡ This Report.

TABLE XVI.—COMPILATION OF AMERICAN ANALYSES OF LAMPONG AND ACHEEN BLACK PEPPER—*Continued.*

Grade.	Importer.	Analyst.	Year.	Weight of 100 corns in grams.	Moisture.	Ash. Total.	Ash. Soluble in water.	Ash. Insoluble in HCl.	Ether extract. Volatile.	Ether extract. Non-volatile.	Alcohol extract.	Reducing matters by direct inversion calculated as starch.	Starch by diastase method.	Crude fiber.	Total N. less N. in non-volatile ether extract, x 6¼.	Nitrogen. Total.	Nitrogen. In non volatile ether extract.	Parts of N. in 100 parts non-volatile ether extract.
Acheen "C"	....	Winton, Ogden, and Mitchell*	1898	2.67	11.84	6.10	3.01	1.04	1.28	9.47	10.28	31.41	26.81	16.40	12.25	2.34	0.38	4.01
" "	Francis H. Leggett & Co., New York	" "	"	2.12	12.33	6.35	3.19	1.00	1.60	9.64	11.07	28.15	22.05	18.25	12.56	2.39	0.38	3.99
" "	E. R. Durkee & Co., N. Y.	Doolittle†	1903	2.82	9.65	8.00	2.60	2.59	2.05	8.08	....	....	33.38	16.63	10.94	2.11	0.36	4.18
" "	E. R. Durkee & Co., N. Y.	"	"	....	9.62	8.04	2.73	2.40	1.80	7.99	.....	....	32.88	17.00	11.25	2.14	0.34	3.94
" "	The A. Colburn Co., Phila.	Winton & Bailey‡	"	3.99	12.11	5.40	2.81	0.88	1.48	8.52	8.90	35.55	28.60	16.56	12.06	2.30	0.37	4.06
" "	E. R. Durkee & Co., N. Y.	" "	"	3.29	11.81	6.26	3.15	1.26	1.64	9.24	9.89	32.98	26.40	17.05	12.31	2.34	0.37	3.82
" "	Stickney & Poor, Boston..	" "	"	3.44	10.84	5.83	3.06	1.09	2.20	9.59	10.63	31.77	24.94	17.70	12.44	2.38	0.39	3.72
	Maximum	....	....	3.99	12.33	8.04	3.19	2.59	2.20	9.64	11.07	35.55	33.38	18.25	12.56	2.39	0.39	4.06
	Minimum	....	....	2.12	9.62	5.40	2.60	0.88	1.28	7.99	8.90	28.15	22.05	16.40	10.94	2.11	0.34	3.72
	Average	....	..	**3.05**	**11.17**	**6.57**	**2.94**	**1.47**	**1.72**	**8.93**	**10.15**	**31.97**	**27.87**	**17.08**	**11.97**	**2.29**	**0.37**	**3.96**
Acheen "D"	E. R. Durkee & Co., N. Y.	Doolittle†	1903	2.46	10.03	7.00	2.53	1.62	1.98	8.81	....	....	28.40	17.98	12.63	2.38	0.36	4.15
" "	E. R. Durkee & Co., N. Y.	"	"	....	10.06	6.75	2.55	1.52	1.66	8.24	....	....	28.00	18.89	12.62	2.38	0.36	4.05
	Average	....	....	....	**10.05**	**6.88**	**2.54**	**1.57**	**1.82**	**8.52**	....	....	**28.20**	**18.44**	**12.62**	**2.38**	**0.36**	**4.10**
West Coast..	....	Richardson§....	1887	5.90	8.91	4.04	....	....	0.70	7.29	....	36.52	....	10.23	....	1.57	....	....
" " ..	....	"	"	6.46	8.15	2.91	....	...	1.48	7.20	5.08	33.92	....	8.74	....	2.18	....	....
" " ..	....	" ...	"	5.08	9.36	4.52	....	....	1.63	7.90	5.71	36.18	....	10.30	....	2.10	....	....
Acheen	....	"	"	4.52	8.29	4.70	....	....	1.69	7.72	6.06	37.50	....	10.02	....	2.02	....	....
"	Austin, Nichols & Co., New York..............	Winton, Ogden, and Mitchell*	1898	2.18	12.33	5.73	3.20	0.64	1.58	10.37	11.86	30.82	25.39	17.08	12.25	2.36	0.40	3.90
.....	Bennett, Simpson & Co., New York..............	Doolittle†	1903	3.69	9.49	6.49	2.97	0.96	1.52	10.44	....	...	33.72	15.04	10.13	2.07	0.45	4.21
West Coast..	The J. P. Dieter Co., Chic.	"	"	3.20	8.73	5.86	2.98	0.83	1.71	9.49	....	....	28.00	16.97	10.00	2.02	0.42	4.02

* Report of this Station, 1898, 199. † Mich. Dairy and Food Dep't., Bul. 94, 8. ‡ This Report. § U. S. Dep't. Agr., Div. of Chem., Bul. 13, Part II, 206.

THE ANATOMY AND MICROSCOPIC IDENTIFICATION OF THE FRUITS OF DARNEL AND CHESS.

BY A. L. WINTON.

In a previous paper* are given the results of botanical and chemical analyses of American wheat screenings and studies of the anatomy of three of the commonest weed seeds of American wheat, viz., black bindweed (*Polygonum Convolvulus* L.), green foxtail (*Setaria viridis* Beauv.), and yellow foxtail (*S. glauca* Beauv.). The anatomical characters of two weed seeds, or rather fruits, ranking next in abundance are described in this paper.

DARNEL.

The microscopic identification of darnel (*Lolium temulentum* L.) is important, as this fruit not only is one of the commonest impurities of European and Californian wheat, but also contains a poisonous principle (temulin) which renders it highly pernicious.

Histology.

Moeller,† Vogl,‡ Macé,§ Villiers and Collin,‖ and other authorities have studied the histology of the fruit and glumes; but have arrived at quite diverse conclusions, especially with regard to the testa or seed-coat and the perisperm or nucellar-layer. Moeller, following the custom prevalent at the time his work was published, classifies as testa, all of the coats between the pericarp or fruit coat and the endosperm; Vogl divides these layers into the testa with two layers and the nucellar-coat with one indistinct layer; Villiers and Collin describe the testa as consisting of one layer and the nucellar-coat of two layers. I find two layers in the testa and two in the perisperm or nucellar-coat.

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* Report of this Station for 1902, 339.
Ztschr. f. Unters. d. Nahr.- u. Genussm., 1903, 6, 433.

† Mikroskopie der Nahrungs- u. Genussmittel. Berlin, 1886, 168.

‡ Die wichtigsten vegetabilischen Nahrungs- u. Genussmittel. Berlin u. Wien, 1899, 32.

§ Les substances alimentaires. Paris, 1891, 300.

‖ Traité des altérations et falsifications des substances alimentaires Paris, 1900, 92.

THE EMPTY GLUME. The four to eight-flowered spikelet is inclosed within a strongly-nerved empty glume which, however, is seldom found in the threshed grain.

Both the flowering glume and the palet are adherent to the caryopsis.

THE FLOWERING GLUME is 6-8 mm. long, equalling or exceeding the caryopsis. It is obscurely five-nerved, lobed at the end, and bears an upwardly-barded awn often 15 mm. long. Like the glumes of barley, oats, and other cereals, it consists of four coats, some of which, however, are lacking on the margins and at the end.

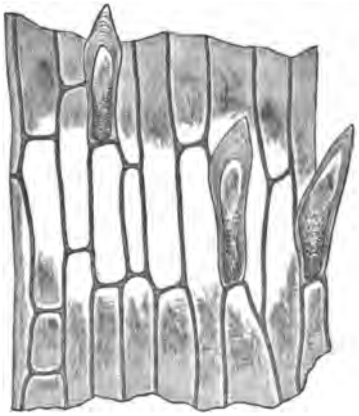

FIG. 1.—Darnel. Margin of flowering glume showing lance-shaped hairs. × 300. (Moeller.)

1. *The Outer Epidermis* differs greatly in structure in different parts of the glume. At the margins (as is clearly shown in Fig. 1 by Moeller*), it consists of straight-walled, elongated cells interspersed here and there with short lance-shaped hairs. On the greater part of the surface, however, the cells, as in barley and some other cereals, are of three kinds: first, cells of wavy outline, into which the straight-walled cells at the margin pass; second, circular cells corresponding to the conical hair-cells of barley; third, exceedingly short, more or less crescent-shaped cells (Fig. 2). Near the margins and on the

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* Mikroskopie der Nahrungs- und Genussmittel, p. 169, Fig. 139.

veins, where they alternate with stomata, the cells of wavy outline are elongated; but in other parts they are very short, often being broader than long. Although thick-walled, the walls are transparent, whereas the middle lamella is conspicuous, giving the impression of thin-walled cells. Pores are few and inconspicuous. Near the margin the circular cells are small and are usually accompanied by crescent-shaped cells which often exceed them in size. On the greater part of the glume, how-

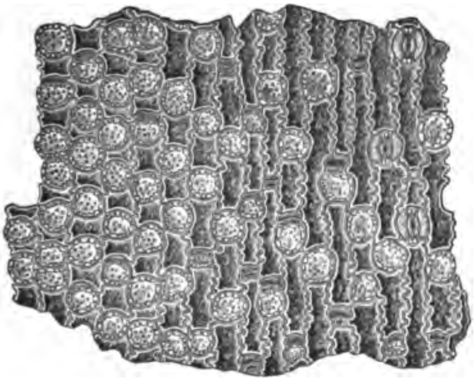

FIG. 2.—Darnel. Middle portion of flowering glume. × 160.

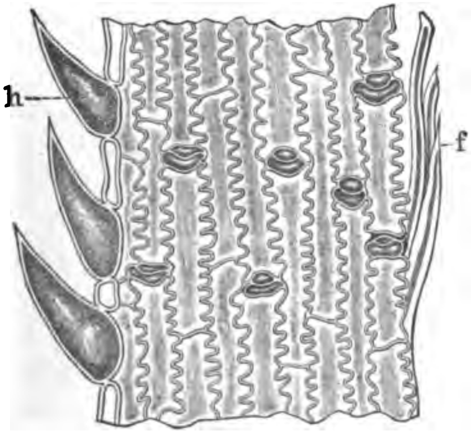

FIG. 3.—Darnel. Keel of palet showing outer epidermis with hair h, and hypoderm fibers f. × 160. (Moeller.)

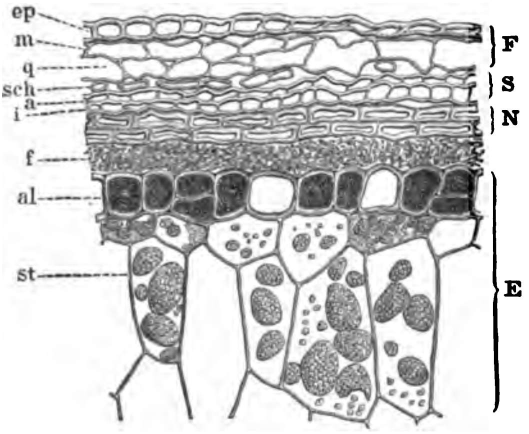

FIG. 4.—Darnel. Transverse section of fruit. F pericarp consisting of epidermis ep, mesocarp m, cross-cells q, and tube-cells sch; S testa consisting of outer layer a, and inner layer i; N perisperm; f fungus-layer; E endosperm consisting of aleurone-layer al, and starch-parenchyma st. × 160.

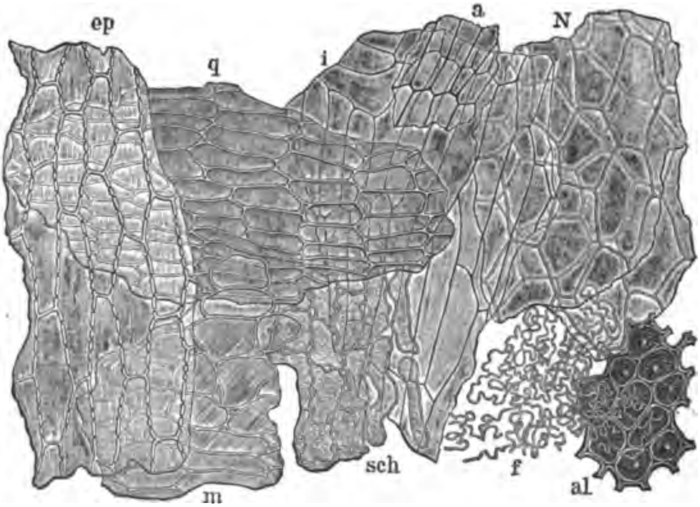

FIG. 5.—Darnel. Elements of fruit in surface view. Significance of letters same as in Fig. 4. × 160.

ever, the circular cells are much larger, often being 70μ in diameter. Numerous pores are conspicuous, both in the radial and tangential walls. Often one, sometimes two, crescent-shaped cells accompany a circular cell.

Characteristic of this coat are the short, wavy cells and the numerous circular cells, the latter frequently exceeding in area the former.

2. *Hypoderm.* The fibers in this layer are much the same as in cereals. Fibers of similar structure also make up the ground-tissue of the awn.

3. *Spongy-Parenchyma.* The elements are more or less rectangular in shape, like those of the corresponding layer of barley, and are readily distinguished from the star-shaped elements of oats.

4. *Inner Epidermis.* This layer is made up of thin-walled cells and stomata, and is of no diagnostic importance.

PALET. The two-keeled palet is about the same size as the flowering glume, but is of a thinner texture, owing to the absence of a well-developed hypoderm-layer.

The Outer Epidermis is much the same as that of the flowering glume, except that it is barbed on the keels with rigid, thorn-like hairs 150μ or less in length, as is shown in Fig. 3 by Moeller.*

THE PERICARP (Fig. 4, F) consists of four coats, of which only two, the epidermis and cross-cells, are fully developed.

1. *Epidermis* (Figs. 4 and 5, ep). Cross-sections of the mature seed show that this layer consists of collapsed, moderately thick-walled cells, which are best studied after heating with potash. Seen in surface view, the cells at the apex of the seed are nearly isodiametric, but at other parts are elongated. The walls are indistinctly beaded.

2. *The Mesocarp* (Figs. 4 and 5, m) is not developed on all parts of the seed, but is conspicuous on the angles. The cells vary greatly in shape and size, some being irregularly-isodiametric, others transversely-elongated, resembling the cells of the next layer.

3. *Cross-Cells* (Figs. 4 and 5, q). Especially striking are the cells of this layer, which resemble the cross-cells of barley. As

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* Mikroskopie der Nahrungs- und Genussmittel, p. 169, Fig. 140.

has been noted by Moeller,* the radial walls appear indistinctly beaded, but this is evident only under favorable conditions.

4. *Tube-Cells,* spongy-parenchyma, and various intermediate forms (Figs. 4 and 5, sch), make up the interrupted inner layer of the pericarp.

TESTA (Figs. 4 and 5, S). The cells are for the most part elongated and are often diagonally arranged with reference to the axis of the fruit. In transverse sections this coat often separates from the pericarp on the one hand and the perisperm on the other. Examined in water, only one cell-layer (the inner) is evident; but successive treatments with 5 per cent. potash, dilute acetic acid and chlorzinc iodine, bring out two layers.

1. *The Outer Layer* (a) is made up of thin-walled cells with cuticularized outer walls. Treated as above described, the cuticle is colored yellow-brown, the radial and inner-walls, blue.

2. *The Inner Layer* (i) is not only thicker than the outer, but the cells are thicker-walled and, in addition, swell greatly with potash. These swollen walls are stained deep blue by chlorzinc iodine, thus differentiating them from the yellow-brown cuticle on the inner wall.

PERISPERM (Figs. 4 and 5, N). Characteristic of this seed is the nucellar-coat, consisting usually of two cell-layers. In cross-section these cells are rectangular with swollen walls; in surface view, as may be seen after soaking for a long time in dilute potash, they are irregularly-polygonal or more or less elongated.

FUNGUS-LAYER (Figs. 4 and 5, F). In most specimens a layer of fungus-threads 20 μ thick is present between the perisperm and the aleurone-layer. So commonly is this fungus present in darnel grown in Europe, that it is of no little value in identifying the grain; but it remains to be determined whether in California, where the plant is a pest in wheat fields, the fungus is also a common accompaniment. After treatment with potash this layer is stained bright yellow by zinc chloride iodine.

ENDOSPERM. 1. *The Aleurone-Cells* (Figs. 4 and 5, al) vary from less than 20 to 40 μ in diameter.

2. *Starch-Parenchyma* (Fig. 4, st). The thin-walled cells contain small polygonal grains 3 to 7 μ in diameter. The indi-

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* Mikroskopie der Nahrungs- und Genussmittel, p. 169, Fig. 140.

vidual starch grains are not distinguishable from the grains of rice and oats, and like the latter often occur in aggregates of various sizes.

Identification of Darnel in Powder-Form.

The characteristic elements of darnel are the outer epidermis of the flowering glumes and palets, and the fungus-layer. The cross-cells and the starch-grains also aid in identification, though the former may be readily confounded with the corresponding tissue of barley and the latter with starch-grains of oats. The spongy-parenchyma of the flowering glume resembles that of barley, but is readily distinguished from the spongy-parenchyma of oat glumes.

CHESS.

Although chess (*Bromus secalinus* L.) is one of the commonest weeds of grain fields, both in Europe and America, and the fruit is a common constituent of uncleaned grain, screenings, and various by-products, most authors on the microscopy of foods give no details as to the anatomical structure. Vogl,* however, describes quite fully the layers of the caryopsis, and notes briefly the structure of the glumes. My own work has included a study of the flowering glumes, palet and fruit, with special attention to the tissues of value in distinguishing this fruit from the cereal grains and darnel.

Histology.

The fruit, when invested by the flowering glume and palet, closely resembles darnel, but the awn of the flowering glume is short or absent.

FLOWERING GLUME. The structure throughout is much the same as in darnel, but the cells of the outer epidermis (Fig. 6) are much more conspicuously thick-walled, and the wavy-walled cells are throughout much longer than broad. The circular cells also have wavy walls. The cells on the margins, interspersed with lance-shaped hairs, are the same as in darnel.

PALET. The flowering glume and palet of chess are very similar in structure, but the outer epidermis of the latter is barbed on the keel, the stiff hairs often reaching 45 μ in length.

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* Die wichtigsten vegetabilischen Nahrungs- u. Genussmittel. Berlin u. Wien, 1899, 36.

PERICARP (Figs. 7 and 8, F). The pericarp consists of two layers with rudiments of another layer in parts.

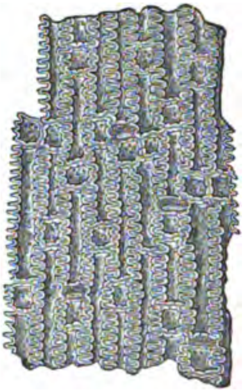

FIG. 6.—Chess. Outer epidermis of flowering glume in surface view. × 160.

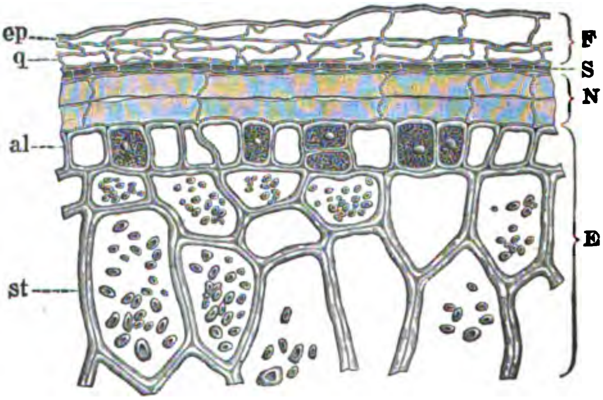

FIG. 7.—Chess. Transverse section of fruit. F pericarp consisting of epidermis ep, and cross-cells q; S testa; N perisperm; E endosperm consisting of aleurone-layer al, and starch-parenchyma st. × 160.

1. *The Epidermal Cells* (Figs. 7 and 8, ep) are large, elongated-polygonal, and have thin, non-porous walls.

2. *Mesocarp.* As a rule, the cross-cells immediately underlie the epidermis; but occasionally traces of the mesocarp are evident.

3. *Cross-Cells* (Figs. 7 and 8, q). Whether this layer corresponds with the cross-cells or the tube-cells of other grasses, I have been unable to decide. The tissue is made up of irregular spongy-parenchyma cells, usually transversely-elongated with large, round or elongated inter-cellular spaces.

THE TESTA (Figs. 7 and 8, S) consists of one layer of elongated brown cells 10-20 μ wide.

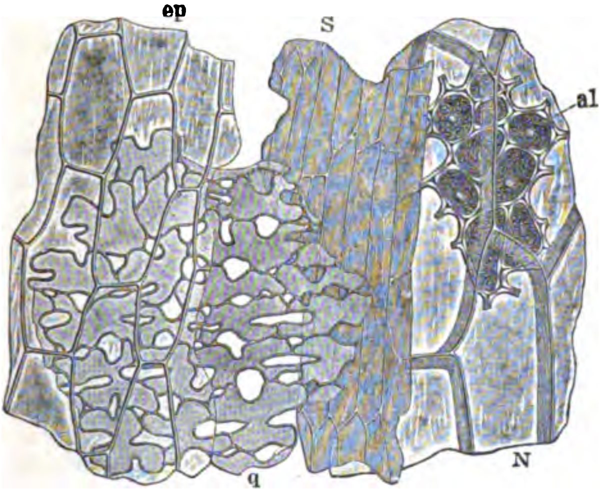

FIG. 8.—Chess. Elements of fruit in surface view. Significance of letters same as in Fig. 7. × 160.

PERISPERM (Figs. 7 and 8, N). This layer is enormously developed. As may be seen in cross-section, the cells are 40 μ thick, but the walls are so swollen as to almost entirely obliterate the cavity. After soaking for some time in 1 per cent. soda solution they are evident in surface view.

ENDOSPERM. 1. *The Aleurone-Layer* (Figs. 7 and 8, al) is not of especial interest.

2. *The Starch-Parenchyma* (Fig. 7, st) is remarkable for the thickness of the cell-walls (often 10 μ thick) and the elliptical starch-grains 3-20 μ in diameter. With proper illumination each grain may be seen to have an elliptical hilum.

Identification of Chess in Powder-Form.

Especially characteristic are the thick-walled parenchyma-cells with elliptical starch-grains. The cross-cells also are of no little diagnostic importance. The flowering glume is distinguished from that of darnel by the bolder outlines of the wavy-walled cells and their greater length, as well as by the structure of the circular cells. The hairs on the keels of the palet are longer than those of darnel.

THE ANATOMY OF CERTAIN OIL SEEDS WITH ESPECIAL REFERENCE TO THE MICROSCOPIC EXAMINATION OF CATTLE FOODS.

BY A. L. WINTON.

The seeds and fruits described in this paper are of economic importance not only for the expressed oil, but also for the residue or cake from the oil presses which serves as cattle food and also in some cases as food for the human family.

HEMP-SEED.

Hemp (*Cannabis sativa* L.) is grown as a fiber-plant throughout Europe, especially in Russia, also in Africa, India, China, Brazil, the United States and other regions.

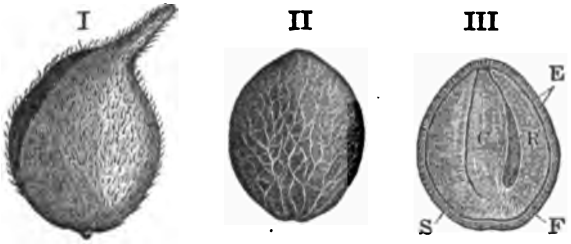

FIG. 9.—Hemp seed. I calyx. II outer surface of fruit. III longitudinal section of fruit. F pericarp; S testa; E endosperm; C cotyledon; R radicle. × 4.

When the production of fiber alone is considered, the plant is cut shortly after blooming; but in Russia it is allowed to grow until the fruit reaches maturity, thus securing a yield of seed as well as fiber. Indian hemp (*Cannabis sativa* var. *Indica*) is grown exclusively as a medicinal herb.

The dioecious plant yields an oval, somewhat flattened, two-ribbed fruit, consisting of a brown pericarp delicately marked with white veins (Fig. 9, II and III, F), a testa of a green color (S), a thin endosperm, and a bulky embryo with thick cotyledons (C) and a radicle (R) bent parallel to the cotyledons. The "seeds" on the market consist, for the most part, of naked fruit, with an occasional fruit inclosed within the hooded calyx (Fig. 9, I).

Histology.

Hitherto our knowledge of the anatomy of hemp-seed has been chiefly confined to the classical researches of Harz,* Benecke,† Tschirch,‡ Boehmer,§ and Tschirch and Oesterle,|| who have described and figured the principal tissues both in cross-section and surface view. I have studied all parts of the fruit and calyx, including the second, third and fourth layers of the pericarp, and the perisperm, none of which are fully described by the authors named.

CALYX. Tschirch and Oesterle and other authors note the structure of the calyx of Indian hemp, and their descriptions apply equally well to the calyx of common hemp.

1. *Outer Epidermis* (Fig. 10, aep). From among the polygonal cells of the epidermis arise two very characteristic and striking elements: first, the glands, either sessile or stalked (d); and second, the cystolith hairs (h). The glands are globular with eight or more cells on the under side radiating, usually, from two central cells, and a secretion cavity formed by the separation of the outer cuticle from these cells. These glands are commonly borne on many-celled stalks, often 300 μ long. The cystolith hairs are characterized by their irregularly-globular bases, often 75 μ in diameter, in which is suspended a cystolith of calcium carbonate. They taper either abruptly or gradually from this base to the pointed apex, in the latter case often reaching a length of 500 μ and sometimes 1 mm. The walls, although but one-half to one-sixth as thick as the lumen, are often 8 μ thick.

2. *Mesophyl* (Fig. 10, mes). Several layers of small cells, through which run numerous bundles, make up the mesophyl. In the inner layer the cells are about 10 μ in diameter and contain crystal-clusters of calcium oxalate.

3. *The Inner Epidermis* (Fig. 10, iep). Cells with wavy outline, thin-walled hairs, and stomata form the inner layer.

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* Landwirthschaftliche Samenkunde, II Bd. Berlin, 1885, 889.

† Anleitung zur mikroskopischen Untersuchung der Kraftfuttermittel. Berlin, 1886, 72.

‡ Angewandte Pflanzenanatomie, I Bd. Wien u. Leipzig, 1889, 163.

§ Koenig, Untersuchung landwirtschaftlich u. gewerblich wichtiger Stoffe, II Aufl. Berlin, 1898, 296. Boehmer, Kraftfuttermittel. Berlin, 1903, 388.

|| Anatomischer Atlas. Leipzig, 1900, 57.

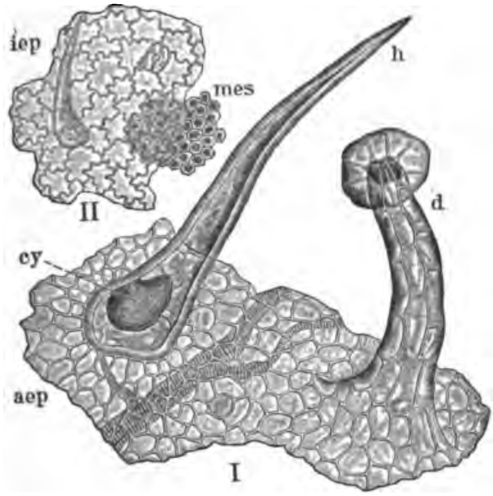

FIG. 10.—Hemp seed. Calyx in surface view. aep outer epidermis with hair h containing a cystolith cy, and glandular hair d; mes mesophyl containing crystals; iep inner epidermis. × 160.

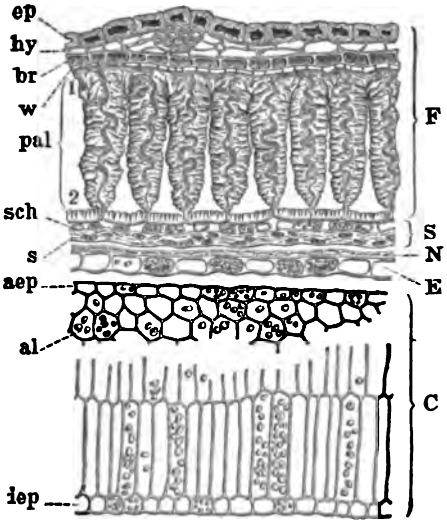

FIG. 11.—Hemp seed. Transverse section. F pericarp consisting of epidermis ep, hypoderm hy, brown cells br, dwarf cells w, and palisade cells pal; S testa consisting of tube cells sch and spongy parenchyma s; N perisperm; E endosperm; C cotyledon with outer epidermis aep, and inner epidermis iep; al aleurone grains. × 160.

PERICARP. 1. *Epicarp* (Figs. 11 and 12, ep). This layer consists of more or less sclerenchymatized cells with wavy outline. The radial walls are, in some parts, moderately thickened, in others so thick that there is but a narrow lumen. All the walls are porous.

2. *Spongy-Parenchyma* (Figs. 11 and 12, hy). One or more layers of colorless cells, usually with numerous circular intercellular spaces, form a hypodermal coat. Through this layer run the numerous anastomosing bundles, which, seen through the epicarp, are evident to the naked eye as veins. This layer is thickest in the two keels of the fruit.

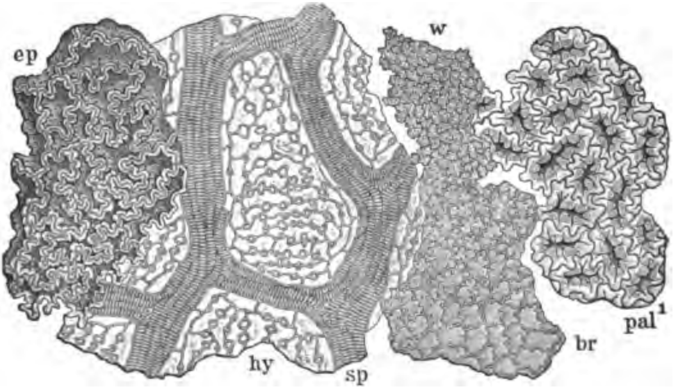

FIG. 12.—Hemp seed. Pericarp in surface view seen from without. Significance of letters same as in Fig. 11. × 160.

3. *Brown-Cells* (Figs. 11 and 12, br). Owing to their greater thickness and the presence of brown contents, these cells are more readily distinguished in cross-section than those of the preceding layer. In preparations obtained by heating the fruit in caustic alkali and scraping, they are conspicuous. Focussing on the outer wall, the radial walls are straight or moderately sinuous; but further inward they are zigzag with projections—often branching—extending into the cell-cavity and forming in each cell what appear to be several indistinct compartments. The cell-contents, after this treatment, form irregular lumps shrunken away from the walls.

4. *Dwarf-Cells* (Figs. 11 and 12, w). Owing to its thinness, this layer can be seen in cross-section only in carefully cut specimens; but in tangential sections or preparations obtained

by the treatment above described, the minute, colorless, porous cells (seldom over 12 μ) with wavy, radial walls are readily distinguished.

5. *Palisade-Layer.* This layer, owing to its thickness (often 100 μ), the peculiarly-thickened porous walls, and the wavy outlines of the radial walls as seen both in cross- and tangential sections, is the most conspicuous and characteristic of all the layers of the fruit. So strongly sclerenchymatized are the outer and, except at the inner end, the radial walls, that the lumen is reduced to a narrow line for fully two-thirds of the outer portion of the cell (Figs. 11 and 12, pal^1); at the inner wall, however, the radial walls abruptly narrow, leaving a wide lumen (Figs. 11 and 13, pal^2). The inner wall is porous and moderately thickened.

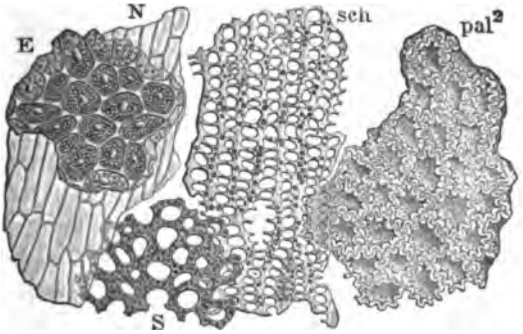

FIG. 13.—Hemp seed. Palisade cells, testa, perisperm and endosperm seen from within. Significance of letters same as in Fig. 11. × 160.

TESTA (Fig. 11, S). The cells of the testa contain green granules, which Tschirch and Oesterle note are insoluble, both in alcohol and ether, and I find insoluble also in alkali.

1. *Tube-Cells* (Figs. 11 and 13, sch). The outer layer is quite distinct from the inner layer, owing to the elongated form of the cells and the elongated rows of intercellular spaces.

2. *Inner Layer* (Figs. 11 and 13, s). Further inward the cells form an indistinct spongy-parenchyma with star-shaped or irregular cell-outlines.

PERISPERM (Figs. 11 and 13, N). This layer of longitudinally-elongated cells appears to have escaped the attention of investigators. If the fruit is soaked for a day or two in 1 per cent. soda solution, the perisperm with adhering endosperm readily separates from the testa on the one hand and the embryo on the other. In cross-section it is indistinctly seen.

THE ENDOSPERM (Figs. 11 and 13, E) forms a coat mostly one cell-layer thick about the whole embryo, and also extends in the form of a partition several layers thick between the cotyledons and the radicle. These cells, containing small protein-grains, resemble the aleurone-cells of the cereals.

EMBRYO (Fig. 11, C). Both epidermal layers of the cotyledons are composed of small cells with aleurone-grains 2-3μ in diameter. Beneath the outer epidermis are several layers of isodiametric cells, while adjoining the inner epidermis are two layers of typical palisade-cells. Both the isodiametric and the palisade-cells contain, in addition to fat, aleurone-grains up to 8μ. Each grain consists of an irregularly-spherical or elliptical body containing a crystalloid with a globoid excrescence.

Microscopic Examination of the Products of Hemp-Seed.

The seeds serve primarily for the production of oil; but the cake from the oil-presses is utilized in various parts of Europe as a cattle food, a fertilizer, and possibly as an adulterant.

The characteristic elements are the epicarp, the spongy-parenchyma with anastomising bundles, the dwarf-cells, the palisade-cells, and the tube-cells of the testa with green contents insoluble in alcohol, ether and caustic alkali.

Extraction with ether, and treatment by Hebebrand's method* may be used to prepare material for examination. If sufficiently large fragments of the shell are obtainable, the palisade-cells are best identified in cross-section, and the dwarf-cells in tangential section. The aleurone-grains, if still intact, may be seen in turpentine mounts.

UPLAND COTTON SEED.

The varieties of upland or short-staple cotton commonly cultivated for fiber are classed under *Gossypium herbaceum* L., although quite probably some of these varieties have been obtained by crossing with other species. Other species of economic importance are Sea Island or long-staple cotton (*G. barbadense* L.), and tree cotton (*G. arboreum* L.).

The culture of cotton has extended from India, its native country, to northern Africa, the southern states of the United States, Brazil, and other warm regions.

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* Landw. Vers.-Stat., 1898, 51, 73.

Within the bolls are borne numerous seeds in a mass of fibers, the latter being but epidermal cells of the testa prolonged as hairs (Fig. 14). After ginning, the seeds of upland cotton are still enveloped by a close ground-fiber, often grey or green in color, which cannot be easily removed. Sea Island cotton seed is nearly free from ground fiber. Freed from the fiber, the pointed, egg-shaped, black or dark brown seed is 6-12 mm. long. The chalaza is a little to one side of the broad upper end, the hilum and micropyle at the pointed lower end, the raphe connecting them being evident as a ridge on the surface. A shell-like testa and a thin skin consisting of perisperm and endosperm enclose the bulky embryo, the latter having cotyledons, which in cross-section are dotted with minute dark-brown resin cavities.

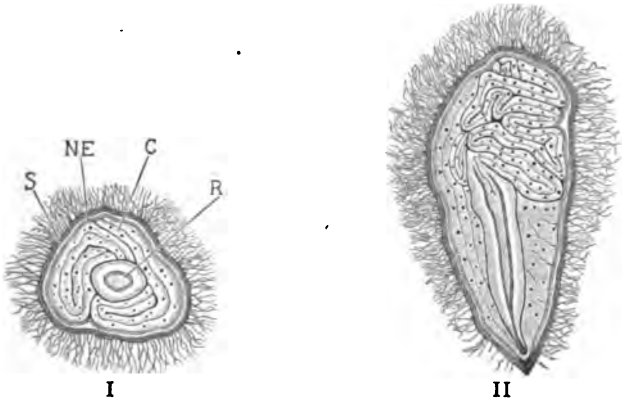

FIG. 14.—Cotton seed. I transverse section. II longitudinal section. S testa; NE perisperm and endosperm; C cotyledons; R radicle. × 4.

Histology.

The anatomy of the cotton seed has been studied by Berg,* Wiesner,† Kobus,‡ Harz,§ Benecke,‖ v. Bretfeld,¶ T. F. Hanausek,* and Boehmer.† Especially noteworthy are the classical researches of v. Bretfeld and T. F. Hanausek, who working independently of each other reached substantially the same conclusions.

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* Atlas zur pharmazentischen Botanik.

† Rohstoffe des Pflanzenreiches, I Aufl., 1873, 726.

‡ Kraftfutter und seine Verfälschung, Landw. Jahrb., 1884, 13, 834.

§ *loc. cit.*, 740.

‖ *loc. cit.*, 68.

¶ Anatomie des Baumwolle- und Kapoksamens. Jour. f. Landw., 1887, 35, 29.

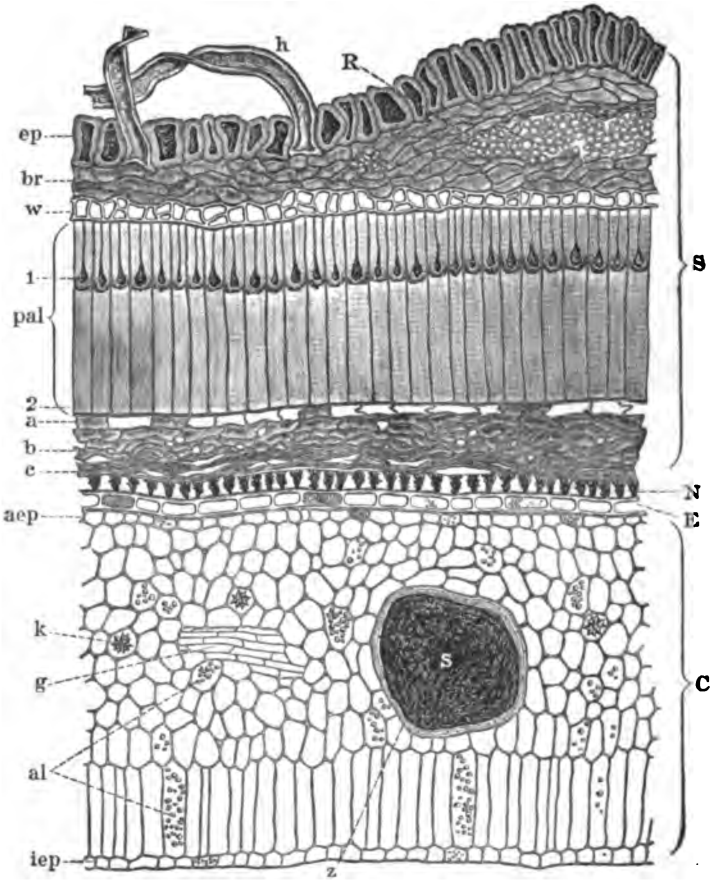

FIG. 15.—Cotton seed. Transverse section. S testa consisting of epidermis ep with hair h, outer brown coat br with raphe R, colorless cells w, palisade cells pal, and layers of inner brown coat a, b and c; N perisperm; E endosperm; C cotyledon with outer epidermis aep and inner epidermis iep; s resin cavity surrounded by mucilage cells z, al, aleurone grains, k crystal cells, g procambium bundles. × 160.

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* Zur mikroskopischen Characteristik der Baumwollsamenproducte, Ztschr. d. allg. österr. Apoth.-Ver., 1888, 26, 591. Realencyklopädie d. ges. Pharm., 1889, 7, 404. Lehrbuch der Technischen Mikroskopie. Stuttgart, 1901, 361. Wiesner, Die Rohstoffe etc. II Aufl., II Bd. Leipzig, 1903, 754.

† Dammer, Lexikon der Verfälschungen, II Bd., 681. Koenig, Die Untersuchung, etc., II Aufl., 287. Boehmer, Kratfuttermittel, 558.

THE TESTA is 300 μ thick, separating readily from the seed. The inner surface is brown with whitish opalescence.

1. *Epidermis* (Figs. 15 and 16, ep). Over the raphe the epidermis is 30-40 μ thick, but in other parts it seldom exceeds 25 μ. The cells are conspicuous because of the thick (5-12 μ), stratified, yellow walls and the dark-brown contents. In surface view, the cells are irregular in shape and vary in size from less than 10 to over 60 μ. About the hairs they form rosettes. The hairs of cotton are twisted, thus distinguishing them from all other textile fibers. Stomata with thin, colorless-walled guard-cells occur either singly or in pairs.

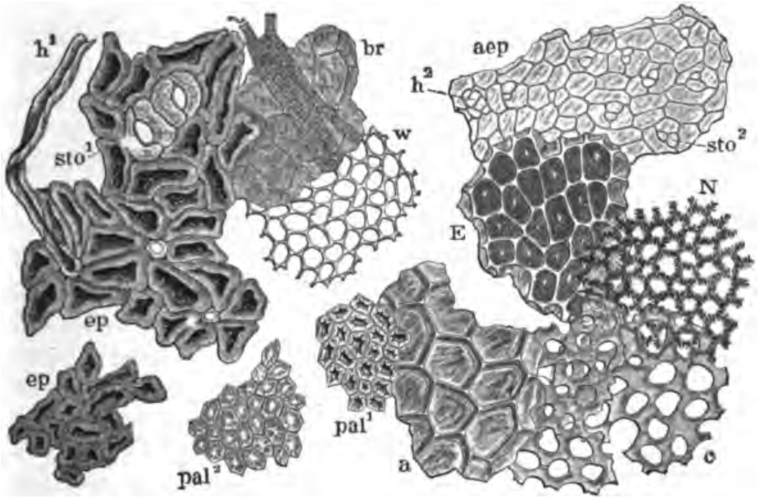

FIG. 16.—Cotton seed. Surface view. Significance of ep, br, w, pal, a, c, N, E, aep same as in Fig. 15. h^1 hair and sto^1 stoma of outer epidermis of testa; h^2 several-celled hair and sto^2 stoma of outer epidermis of cotyledon, in early stages of development. × 160.

2. *Outer Brown Coat* (Figs. 15 and 16, br). The hypodermal coat consists of thin-walled, often compressed cells, with indistinct contour and brown contents. Over most of the surface, this coat is but 20-40 μ thick and consists of only 2 or 3 cell-layers, but about the raphe it is several times thicker.

3. *Colorless Cells* (Figs. 15 and 16, w). The next layer consists of small (10-30 μ), colorless cells, with sharply defined walls 2-3 μ thick. Cells divided by tangential partitions occur not infrequently. Hanausek states that these cells contain occa-

sional oxalate crystals or granular masses; most of them, however, are empty.

4. *Palisade-Cells* (Figs. 15 and 16, pal). Over one-half of the thickness of the testa is due to the thickened palisade-cells. These remarkable and exceedingly characteristic cells are 8-20 μ wide, and about 150 μ long, each consisting of an outer portion of about one-third the length of the cell with nearly colorless walls, and an inner portion with yellowish brown walls. In the outer portion a narrow lumen extends from the outer nearly to the inner end, where it broadens into a cavity, 4-6 μ in diameter, containing a dark colored material. Seen in tangential section, this cavity has radiating branches. An indistinct light line adjoins the outer wall. No lumen at all appears in the inner portion of these cells in cross-section, but in tangential section faint radiating lines are evident, due, according to von Bretfeld, to *lamellae* arranged about the axis of the cell. Individual cells isolated by macerating with Schulze's solution and treated with chromic acid show clearly this differentiation. The same author found that the outer portion has all the chemical and optical properties of pure cellulose, the inner portion those of lignified cellulose. Cross-sections viewed with polarized light exhibit with a dark field a beautiful play of color in the outer, a clear white light in the inner portion.

5. *The Inner Brown Coat* (Figs. 15 and 16). In the outer layer of this coat (a), the cells are polygonal, and well defined both in cross-section and surface view. Proceeding inward, the tissue takes on the characters of a typical spongy-parenchyma, the cells in the innermost layers being much compressed (b and c). Brown coloring matter like that in the second layer of the testa is usually present only in the cells of the outer layers. Owing to the absence of cell-contents in the inner obliterated cells, the inner surface of the testa is more or less opalescent.

Perisperm (Figs. 15 and 16, N). An exceedingly thin skin consisting of a single cell-layer of perisperm and another of endosperm, covers the embryo. The colorless perisperm cells are characterized by the fringe-like walls made up of threads perpendicular to the surface. Hanausek's name, "fringe-cells," is very appropriate.

Endosperm (Figs. 15 and 16, E). A single layer of moderately thick-walled cells containing small aleurone-grains constitutes the endosperm.

EMBRYO. After soaking for a day in water, the complicated folds of the cotyledons (Figs. 16, C) may be straightened out and their broad kidney shape noted.

By scraping the cotyledons the epidermis (Figs. 15 and 16, aep) may be removed for examination. As was first noted by Hanausek, three kinds of cells are present: first, thin-walled polygonal cells; second, pairs of cells with curved walls, the guard-cells of incipient stomata (sto^2); and third, small cells continued beyond the surface in the form of oval hairs, divided into several cells by cross partitions (h^2). The hairs are most abundant at the point of insertion on the axis.

Sections of the cotyledons and radicle may be cut dry without removing the testa, although better sections are obtained after removing the testa and imbedding directly in paraffine.

For studying the cell structure, the sections are treated successively with ether, alcohol, and water, and finally mounted either in water or glycerine.

In the outer portion of the mesophyl, the cells are isodiametric, in the inner layers, of typical palisade-form. Procambium bundles (Fig. 15, g) run longitudinally or obliquely through the mesophyl.

Crystal clusters (Fig. 15, k) occur in cells scattered here and there, but in most of the mesophyl cells aleurone-grains and fat are the only visible contents. The aleurone-grains (al) may be studied in sections mounted in turpentine. They are 2–5 μ in diameter and are more or less angular or irregular in shape. Caustic alkali dissolves the aleurone-grains and other contents and imparts a deep yellow color to the tissues.

The so-called resin-cavities of the cotyledons (s), containing a dark-colored secretion, appear to the naked eye as brown dots in the nearly colorless ground-tissue. Around these cavities two or more indistinct rows of exceedingly thin, elongated cells (the mucilage cells of Hanausek) are arranged in concentric layers.

We are indebted to Hanausek for the following observations: Examined in water, the secretion is olive-green, flowing out of the cavities in the form of a yellow-green emulsion, the particles of which are in lively motion. Strong sulphuric acid dissolves the secretion to a beautiful blood-red solution. Alkalies color it green-brown, but do not dissolve it.

Microscopic Examination of Upland Cotton Seed Products.

Undecorticated Cotton Seed Cake. It is customary in India, Egypt, in fact most cotton-growing countries, except the United States, to express the oil without previous removal of the hulls. The cake obtained as a by-product in this process, although containing more fiber and less protein than the decorticated cake, is preferred by the English feeders, because of the mechanical action of the hulls.

Samples should be mounted in water and examined first directly to detect possible starchy adulterants, and again after addition of caustic alkali, noting the fragments of testa and the yellow color of the disorganized lumps. The coats of the testa are best studied in fat- and protein-free material obtained by the crude-fiber process or by Hebebrand's method.*

Especially characteristic are the thick-walled epidermal cells with hairs and the palisade-cells, although the other layers aid in identification. The fringe-cells of the perisperm are characteristic, but not so conspicuous as are the layers of the testa.

The cake or meal from common cotton contains more fiber (often attached to fragments of hull) and less abundant brown pigment in both the outer brown layer and the inner testa, than products of the varieties of *G. barbadense* (Sea Island Cotton, Egyptian Cotton, etc.). Voelcker† places considerable dependence on the more or less pronounced opalescent appearance of the inner surface of the testa of Bombay seed as distinguished from the deep-brown inner surface of the hulls from Egyptian seed, a distinction which also holds good in most cases between Upland and Sea Island seed as grown in the United States. This observation, first brought to notice by Richardson of Lincoln, England, depends on the degree of obliteration of the innermost cells of the testa.

Decorticated Cotton Seed Cake. In the United States, upland cotton seed is hulled before expressing the oil, the cake and the rich yellow meal obtained by grinding the cake consisting of material from the cotyledon with only a small amount of testa. This meal is often grossly adulterated with ground cotton hulls, and occasionally with rice refuse. Finely ground hulls, owing partly to the fine state of division of the dark-colored matter, and partly to the exposure of the nearly colorless palisade-cells, is not so dark as the coarsely ground hulls and more readily escapes detection in the meal.

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* Landw. Vers.-Stat., 1898, 51, 75.
† Analyst, 1903, 28, 261.

Determinations of nitrogen and fiber, coupled with microscopic examination of the original material and the crude fiber, serve for the detection of this form of adulteration.

Cotton Hulls formerly were burned as a fuel under the boilers of the oil mills, and the ash, rich in potash, utilized as a tobacco fertilizer. They are now used for feeding cattle or as an adulterant of cotton seed meal, as noted above.

SESAME SEED.

Common sesame (*Sesamum Indicum* L.) is one of the most valuable cultivated plants in India, China, Asia Minor, Palestine, Arabia and other parts of the Orient, the seeds serving for the production of oil and cake, also for direct consumption as human food. The plant is also to some extent cultivated in Egypt, parts of East Africa, and in the warmer parts of North and South America.

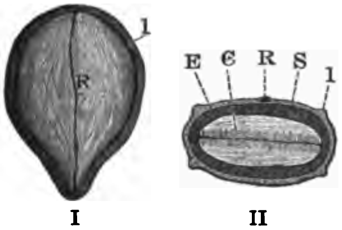

FIG. 17.—Sesame seed. I outer surface. II transverse section. S testa with ridges l and raphe R; E endosperm; C cotyledon. × 8.

The flattened pear-shaped seeds (Fig. 17) are 2-3 mm. long and vary in color from white to brown. Passing longitudinally through the center of one of the flattened sides, is the raphe (R), and running around the edge of each of the flattened surfaces is an indistinct ridge conforming to the shape of the seed (l). The endosperm (E) is about half as thick as the cotyledon (C).

Histology.

The histology of the sesame has been studied by Kobus,* Harz,† Benecke,‡ Boehmer,§ Hebebrand,‖ and Hanausek.¶

TESTA (Fig. 18, S). 1. *Epidermis* (Figs. 18 and 19, ep). The cells throughout are radially elongated with convex outer walls. Owing to the thinness of the radial walls, they are usually collapsed, but assume their normal form on heating cross-sections with dilute alkali. The cells forming the ridges are empty and, as was first noted by Benecke, are arranged like the vanes of a feather. In other parts the cells are parallel and each contains in the extreme outer end, adjoining the thin outer wall, an irregularly spherical mass consisting of calcium

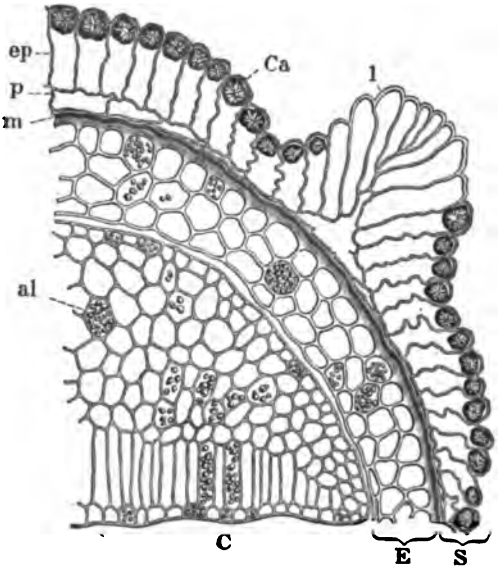

FIG. 18.—Sesame seed. Transverse section. S testa consisting of epidermal cells ep containing crystal masses Ca, parenchyma p, and yellow membrane m; l epidermal cells of ridges; E endosperm; C cotyledon containing aleurone grains al. × 160.

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* loc. cit., 813.

† loc. cit., 960.

‡ loc. cit., 57.

§ Dammer, Lexikon, II Bd., 683. Koenig, Die Untersuchung, etc., 289. Boehmer, Die Kraftfuttermittel, 494.

‖ Uber den Sesam, Landw. Vers.-Stat., 1898, 51, 45.

¶ Technische Mikroskopie, 377. Wiesner, Rohstoffe, II Aufl., II Bd., 768.

oxalate crystals, apparently within a thin membrane (Ca). These masses are 12-40 μ in diameter. In surface view, as may be clearly seen by examination of the skin which separates after boiling the seed in water, the crystal cells are isodiametric-polygonal (Fig. 19, ep), the cells of the ridges slightly elongated (l). By boiling with alkali on the slide, some of the epidermal cells may be isolated and, after staining with chlorzinc iodine, viewed in a horizontal position. Sometimes the crystal masses are disintegrated, the separate crystals presenting the appearance shown in Fig. 19. In some specimens which I have examined, all the masses were disintegrated.

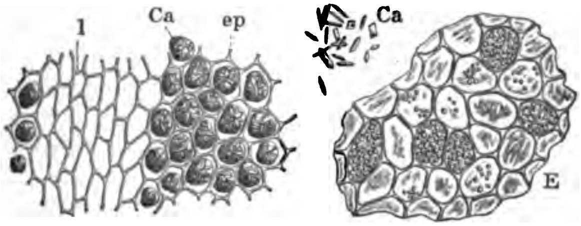

FIG. 19.—Sesame seed. Testa and endosperm in surface view. Significance of letters same as in Fig. 18. × 160.

2. *Parenchyma* (Nutritive Layer) (Fig. 18, p). One, sometimes more, layers of collapsed cells form what in the earlier stages of growth was a nutritive layer. Only after heating with potash is the cellular structure at all evident in cross-section and then but indistinctly. After removing the epidermis as above described and treating the seed with safranin or chlorzinc iodine, colored fragments may be removed from the surface of the seed, which often show longitudinally-elongated cells. Hanausek has noted that the cells contain loose crystals of calcium oxalate.

3. *Yellow Membrane* (Fig. 18, m). Lining the inner surface of the testa is a membrane, probably the cuticle of an obliterated inner epidermis.

ENDOSPERM (Figs. 18 and 19, E). The outer wall of the endosperm is strongly thickened. At the ends of the elliptical cross-sections there are but two cell-layers, but on the sides there are three to five layers. The cells contain aleurone-grains (2-6 μ), and fat.

EMBRYO (Fig. 18, C). The cells of the cotyledons, except in the single layer of palisade-cells, are isodiametric and like those of the endosperm contain aleurone-grains (up to 10μ) and fat, but no starch. Hanausek states that each grain contains either a crystalloid or, at one of the poles, a globoid.

Microscopic Examination of Sesame Products.

Not only is sesame oil one of the most valuable of the vegetable oils, but the seed itself is an ingredient of various articles of diet throughout the warmer countries of the East, and the cake obtained as a by-product in the manufacture of the oil serves as food for both man and beast. Sesame cake has been imported into Europe in large amount, where it is highly esteemed by cattle feeders.

Samples of sesame cake may be prepared for examination by Benecke's or Hebebrand's method or by simply boiling with 1 per cent. caustic alkali. Previous extraction with ether is desirable.

Characteristic of common sesame are radially elongated, thin-walled epidermal cells, each with a crystal mass in the outer end. In black sesame (*S. radiatum S. et T.*) the masses are in the inner end of the cell, where the cell-wall is strongly thickened.

MADIA SEED.

Common tar weed, known in Chile as "Madi" (*Madia sativa* Mol.), is one of several species of this genus natives of the Pacific coast of North and South America. It is cultivated as an oil-seed in parts of the American continent and more extensively in Germany.

The slender, ribbed achenes, 4-8 mm. long, 2 mm. wide at the apex tapering to the base, are borne in heads 3-6 cm. in diameter. The achenes are usually light in color, but sometimes are nearly black.

Histology.

The microscopic structure of madia seed has been studied by Harz,* Benecke,† Pfister,‡ Boehmer,§ and Hanausek.||

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* loc. cit., 855.

† loc. cit., 76.

‡ Oelliefernde Kompositenfrüchte. Landw. Vers.-Stat., 1894, 43, 441.

§ Koenig, Untersuchung, etc., II Aufl., II Bd., 298. Boehmer, Kraftfuttermittel, 463.

|| Technische Mikroskopie, 374.

PERICARP (Fig. 20, F). 1. *Epidermis* (Figs. 20 and 21 ep). The cells are longitudinally elongated, variable in size, with colorless, distinctly-beaded walls and a thickened cuticle.

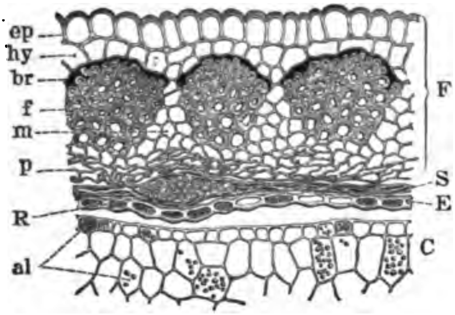

FIG. 20.—Madia seed. Transverse section. F pericarp consisting of epidermis ep, hypoderm hy, pigment plates br, fiber bundles f, partitions m, and parenchyma p; S testa; E endosperm; C cotyledon containing aleurone grains al. × 160.

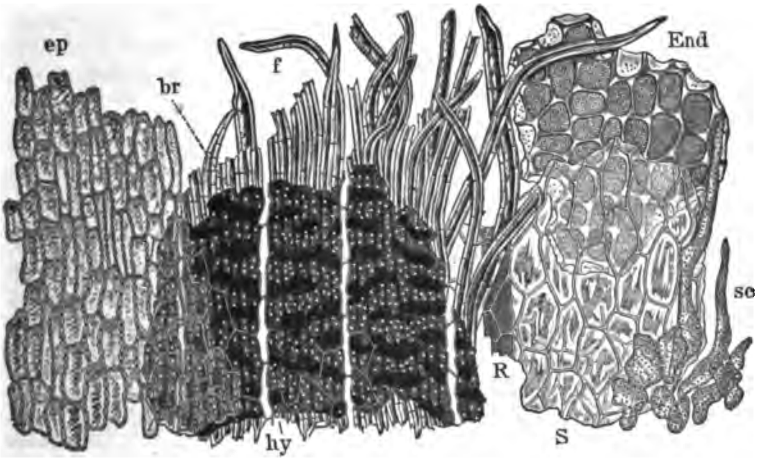

FIG. 21.—Madia seed. Pericarp, testa and endosperm in surface view. Significance of ep, hy, br, f, R, S and E same as in Fig. 20; sc pitted cells at base of testa. × 160.

2. *Hypoderm* (Fig. 20, hy). Thin-walled more or less collapsed cells form the second layer.

3. *Pigment-Plates* (Figs. 20 and 21, br). As in niger seed and some varieties of sunflower, the fiber-bundles are covered with dark colored plates of a material insoluble in all the com-

mon reagents, including boiling alkali. In surface view the markings, resembling those of a tortoise shell, due to the variable thickness of the pigment material, and the rows of minute pores appearing as light spots in the dark field, make this layer the most striking in the fruit. Hanausek has shown that these plates in the sunflower result from the obliteration of a distinct cell-layer.

4. *Fiber-Bundles* (Figs. 20 and 21, f). The fibers are 5-15 μ in diameter and often are 1 mm. long, being smallest in the outer layers. Between the bundles are groups of thin-walled, more or less longitudinally-elongated cells, forming wedge-shaped partitions (m).

5. *Parenchyma* (Fig. 20, p). Several cell-rows of partially collapsed parenchyma-cells form the inner layers of the pericarp.

THE TESTA (Figs. 20 and 21 S) consists of one distinct layer of parenchyma-cells without any striking characters, and other less distinct layers near the raphe bundles.

Curiously shaped, pitted cells (Fig. 21, sc), some nearly isodiametric, others greatly elongated, are present at the base of the seed, the longer forms extending in bundles toward the apex. These bundles appear to be distinct from the raphe and its ramifications.

THE ENDOSPERM (Figs. 20 and 21, E) is represented by a single layer of thick-walled, often quadrilateral, aleurone-cells.

EMBRYO. Beneath the outer epidermis of the folded cotyledons (Fig. 20 C) are several layers of isodiametric cells, but adjoining the inner epidermis are three to four layers of typical palisade-cells. Aleurone-grains (2-6 μ) and fat are the only visible contents.

Microscopic Examination of Madia Seed Products.

Madia fruit has much the same structure as sunflower and niger fruits; but is distinguished from the former by having no hairs on the epicarp, a single layer of hypodermal cells, and fibers with relatively small diameters; while it differs from niger seeds in having the walls of the epicarp beaded, an inconspicuous hypoderm layer (no rail-shaped cells), and the walls of the testa straight and non-porous.

Niger Seed.

The fruit of *Guizotia Abyssinica* (L) Cass. (*G. oleifera* D.C.), a composite plant, is an important oil-seed in Abyssinia, its native country, and also in India. It has been introduced into Europe and America, but has not been extensively cultivated as yet.

The black achenes are shaped like those of madia, but are much smaller, seldom over 5 mm. long and 1 mm. broad at the apex.

Histology.

The microscopic structure of niger seed has been studied by the authors noted under madia.

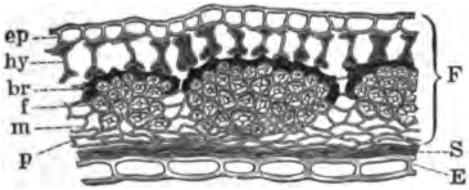

Fig. 22.—Niger seed. Transverse section. F pericarp consisting of epidermis ep, hypoderm hy, pigment plates br, fiber bundles f, partitions m, and parenchyma p; S testa; E endosperm. × 300.

Pericarp (Fig. 22, F). 1. *The Epicarp* cells (Figs. 22 and 23, ep) are distinguished from those of madia by their greater length and the absence of pores.

2. *Hypoderm* (Figs. 22 and 23, hy). Pfister has shown that the isolated, longitudinally-elongated cells of this layer are shaped like railway rails, resembling in cross-section the hour-glass cells of the legumes. The color of the seed is largely due to the black pigment in this layer.

3. *The Pigment-Plates* (Figs. 22 and 23, br) are similar to those of madia seed, but the cross-markings are nearer together and not so distinct.

4. *The Fiber-Bundles* (Figs. 22 and 23, f) are smaller than the similar bundles of madia, and the individual fibers are narrower.

5. *Parenchyma.* The partitions between the fiber-bundles (Fig. 22, m), and also the inner layers of the pericarp (p), consist of parenchyma-cells which, in the layers adjoining the testa, are usually compressed.

TESTA. 1. *Reticulated Cells* (Figs. 22 and 23, S). Characteristic of this seed are the reticulated cells with wavy side-walls, forming the outer layer of the testa.

2. *Inner Testa.* One or more layers of obliterated cells form the inner layers of the testa.

ENDOSPERM (Figs. 22 and 23, E). As in madia, the endosperm consists of a single layer of thick-walled aleurone-cells, often of rectangular outline.

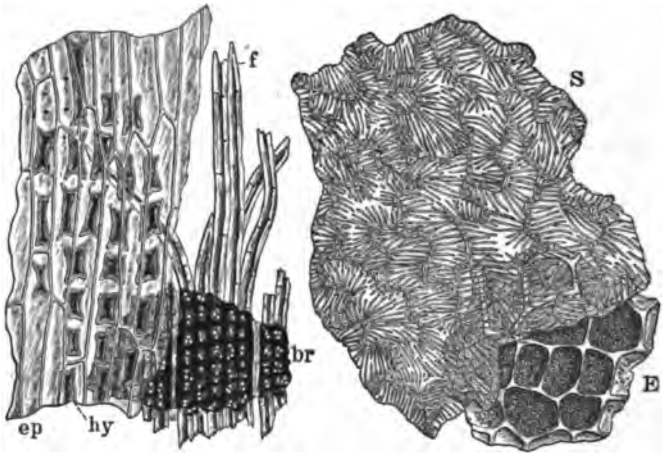

FIG. 23.—Niger seed. Pericarp, testa and endosperm in surface view. Significance of letters same as in Fig. 22. × 300.

EMBRYO. The thin-walled cells of the embryo contain aleurone-grains and fat, and are not distinguishable from those of madia.

Microscopic Examination of Niger Seed Products.

Niger cake is utilized as a cattle food. The characteristic elements are the rail-shaped cells of the hypoderm with their dark contents, and the outer layer of the testa. These are rendered distinct by treatment with caustic potash.

POPPY-SEED.

The poppy-plant (*Papaver somniferum* L.), a native of the Orient, is now cultivated in various parts of the Old and New World.

Two distinct varieties are recognized, the white, and the black or blue. The white poppy is grown chiefly for the production of opium, the black for the seed, from which is expressed poppy-oil.

The anatropous seeds (Fig. 24), are very small, seldom over 1 mm. long, and kidney-shaped, one end being slightly broader than the other. The hilum and chalaza are in a notch, connected by a short raphe, the chalaza being nearer the broad end of the seed, the hilum nearer the narrow end. Under the lens the surface is beautifully reticulated. The straight embryo is embedded in the bulky endosperm.

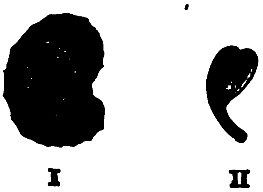

FIG. 24.—Poppy seed. I seed. II embryo. × 16.

Histology.

Several authors have worked on the anatomy of this difficult seed. Berg,[*] Michalowski,[†] Harz[‡] and Benecke[§] among the early investigators, contributed some important facts, but their work was incomplete and in some details erroneous. We are indebted to Meyer[||] for our present knowledge of the anatomy of this seed and to Tschirch and Oesterle,[¶] Boehmer,[**] Vogl,[††] Mach[‡‡] and Hanausek,[§§] who have since corroborated the main points of Meyer's descriptions. My own investigations have led to substantially the same conclusions, except as regards the inner layer. Figs. 25 and 26, reproduced herewith from my drawings, were designed to convey a clear idea of the structure of the first and second layers and are believed to be more in accord with the facts and, indeed, with the descriptions of Meyer and Hanausek, than the figures of the two last named authors.

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[*] Anatomischer Atlas. Berlin, 1865, 92.

[†] Beitrag zur Anatomie und Entwicklungsgesch. von *Papaver somniferum* L., I. Teil, Dissertation, Grätz, 1881.

[‡] *loc. cit.*, 990.

[§] *loc. cit.*, 60.

[||] Wissenschaftliche Drogenkunde, I Teil. Berlin, 1891, 157.

[¶] Anatomischer Atlas, 63. Kleine Beiträge zur Pharmakobotanik und Pharmakochemie, Schweizer Wochenschrift f. Chemie u. Pharm., Nr. 17.

[**] Koenig, Die Untersuchung, etc., 292. Kraftfuttermittel, 477.

[††] *loc. cit.*, 239.

[‡‡] Landw. Vers.-Stat., 1902, 57, 419.

[§§] Technische Mikroskopie, 389. Wiesner, Die Rohstoffe, II Aufl., II Bd., 711.

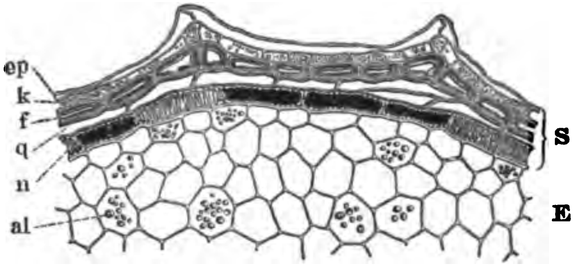


FIG. 25.—Poppy seed. Transverse section. S testa consisting of epidermis ep, crystal layer k, fiber layer f, cross cells q and netted cells n; E endosperm containing aleurone grains al. × 160.

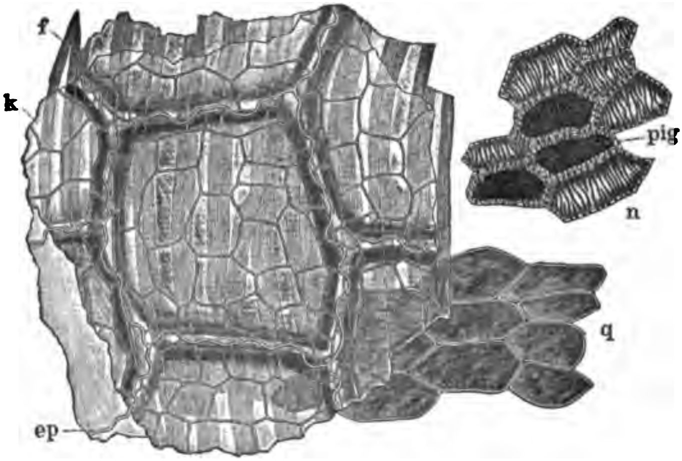


FIG. 26.—Poppy seed. Testa in surface view. Significance of letters same as in Fig. 25. pig pigment. × 160.

TESTA (Fig. 25, S). Cross-sections are prepared after soaking the seed in water and may be cleared with chloral or alkali. After soaking the whole seed for about twenty-four hours in 1 per cent. sodium hydrate solution, the first four layers readily separate from the fifth. Subsequent treatment with hydrochloric acid dissolves out the calcium oxalate, and staining with chlorzinc iodine or safranin renders the outer layers more distinct.

1. *The Epidermical Cells* (Figs. 25 and 26, ep) are polygonal and of enormous size, corresponding to the network on the seed. As appears in cross-section, the cells are collapsed except in the neighborhood of the radial walls. In surface view the radial walls are sinuous and thin, what are often considered the thick dark walls of this layer being not the walls at all, but the ribs formed by the thickening of the second and third layers. This conclusion is consistent with Meyer's and Hanausek's figures of cross-sections, also with Meyer's drawings and Mach's photomicrographs of surface preparations. The statement of Tschirch and Oesterle that the epidermis consists of elongated cells situated over the ribs, with large polygonal cells between, has since been corrected by the authors themselves. Doubtless they mistook some of the cells of the second layer for epidermis. Hanausek's surface view, on the other hand, might convey the impression that the ribs were the cell walls, but his description and cross-section clearly show their true nature.

2. *Crystal-Layer* (Figs. 25 and 26, k). On the ribs, the cells of this layer are more or less tangentially elongated, but between the ribs are isodiametric and polygonal, the elongated cells having longer radial walls than the others, thus contributing to the formation of the ribs. They contain fine, granular crystals of calcium oxalate. Meyer has demonstrated that the blue color of the poppy-seed is due, not to a blue pigment, but to the interference of light by the crystals over the brown cells in the background, and is the same phenomenon as causes the apparent blue color of the sky and the iris of the eye. As soon as these crystals are dissolved in hydrochloric acid, the seed appears brown.

3. *Fiber-Layer* (Figs. 25 and 26, f). The fibers of this layer are 15-40 μ broad and are parallel to the curved axis of the seed. Seen in cross-section, this layer is thickest in the ribs, the walls throughout being distinctly thickened and stratified. In surface view they are rendered more distinct by chlorzinc iodine.

4. *Cross-Cells* (Figs. 25 and 26, q). The fourth layer consists of moderately thick-walled, transversely-elongated, pointed

cells arranged side by side in rows. The walls are impregnated with a brown material.

5. *Netted-Cells* (Figs. 25 and 26, n). Owing to the netted-veined, colorless walls and the presence of deep brown contents, these cells are particularly striking. They are arranged transversely and often side by side in rows. The cell contents are insoluble in alkali and do not give the tannin reaction.

Some authors designate the cells of this layer "Pigment cells," notwithstanding the fact that in the white poppy they do not contain pigment.

Meyer, Tschirch and Oesterle, Vogl, and Hanausek describe an inner layer of thin-walled cells, but I am unable to find such a layer except in the vicinity of the hilum.

THE ENDOSPERM (Fig. 26, E) contains aleurone-grains up to 3 μ in the outer layers and 7 μ in the inner layers, each grain containing several globoids and crystalloids.

EMBRYO. In the cotyledons there is only one layer of palisade-cells and these cells are only slightly elongated. The aleurone-grains are like those of the endosperm.

Microscopic Examination of Poppy-Seed Products.

Poppy-seeds are used in bread and pastries; poppy-cake, the by-product in the manufacture of poppy-oil, is fed to cattle.

The ground powder should be examined directly, also after soaking successively in 1 per cent. soda solution and in hydrochloric acid, or after treatment by Hebebrand's method. Fragments showing the ribs, consisting of the first four layers, and separate fragments of the layers of netted-cells with brown contents, are readily identified.

THIRD REPORT

OF THE

STATE ENTOMOLOGIST OF CONNECTICUT

To the Director and Board of Control of the Connecticut Agricultural Experiment Station:

Under the laws of Connecticut the State Entomologist is required to make an annual report, and I herewith transmit my third Report. During the year the Insect Pest Law has been so amended that the authority and the duties of the State Entomologist have both been somewhat increased. In this, as in previous Reports, the insect work is recorded for the calendar year of 1903, but the financial statement covers the State fiscal year ending September 30, 1903.

Respectfully submitted,
W. E. BRITTON,
State Entomologist.

REPORT OF THE RECEIPTS AND EXPENDITURES OF THE STATE ENTOMOLOGIST FROM OCTOBER 1ST, 1902, TO SEPTEMBER 30TH, 1903.

RECEIPTS.

From E. H. Jenkins, Treasurer		$1,914.76
Adams Express Co., repairs on damaged pump		4.95
S. J. Griffin, for oil		1.44
Various sources for electrotypes		8.05
		$1,929.20

EXPENDITURES.

Field, office and laboratory assistance	$ 752.74	
Printing and illustrations	431.34	
Postage	3.27	
Stationery	1.80	
Telephone and telegraph	2.80	
Express, freight and cartage	40.09	
Library	155.63	
Laboratory apparatus and supplies	170.16	
Spraying apparatus and supplies	132.40	
Office supplies	7.60	
Traveling expenses	211.44	
	$1,909.27	
Balance, cash on hand	19.93	
		$1,929.20

Memorandum—This account of the State Entomologist has been duly audited by the State Auditors of Public Accounts.

THE CONNECTICUT LAW RELATING TO INSECT PESTS AND PLANT DISEASES.

AS AMENDED BY THE

GENERAL ASSEMBLY OF 1903.

The General Assembly of 1901 first enacted a law concerning insect pests which has been published in bulletin 134 of this Station and also in the first report of the State Entomologist (Report of this Station for 1901, Part III, p. 229).

The General Statutes of the State were revised by a committee on revision during the years 1901-1903 and the insect pest law as revised by this committee and adopted by the General Assembly at the beginning of the session of 1903 was printed in the second report of the State Entomologist (Report of this Station for 1902, Part II, p. 100). Later, during the session of 1903, two amendments were passed. These amendments to Sections 4387 and 4388 are herein printed in full-faced type.

THE INSECT PEST LAW.

Chapter 238, General Statutes of Connecticut.

Section 4386. State entomologist; appointment. Said board of control shall appoint a state entomologist to hold office during the pleasure of the board, who shall have an office at the experiment station, but shall receive no compensation other than his regular salary as a member of the station staff. He may appoint such number of deputies, not exceeding three, as he may deem necessary.

Sec. 4387. Duties. The state entomologist, either personally or through his deputies, shall visit any orchard, field, garden, nursery, or storehouse, on request of the owner, to advise treatment against pests. He may inspect any orchard, field, or garden, in public or private grounds, which he may know or have reason to suspect to be infested with San José scale or any serious pests **or infectious diseases, when in his judgment such pests or infectious diseases are a menace to adjoining owners; and may order the owner, occupant, or person in charge thereof, in writing, to properly spray or give other suitable**

treatment, or to cut and destroy any such diseased trees or shrubs, if in the opinion of the state entomologist such action is necessary, and the owner thereof shall not recover from nor be recompensed therefor by the state. If the owner of such orchard, field, or garden neglects or refuses to comply with the order of the said state entomologist, he shall be fined not more than fifty dollars. The state entomologist may issue such bulletins of said experiment station as in his judgment are needed to convey information about pests; may conduct experiments and investigations regarding injurious insects and the remedies for their attacks; diffuse such information by means of correspondence, lectures, and published matter; and may employ such assistants in his office, laboratory, or in the field, and purchase such apparatus and supplies as may be necessary. He shall keep a detailed account of expenses, and publish each year a report of such expenses, and of the work done.

Sec. 4388. Certificate of inspection of nursery stock. All nursery stock shipped into this state from any other state, county, or province, shall bear on each package a certificate that the contents of said package have been inspected by a state or government officer and that said contents **have been thoroughly fumigated and** appear free from all dangerous insects or disease. In case nursery stock is brought within the state without such a certificate, the consignee may return it to the consignor at the latter's expense, or may call the state entomologist to inspect the same and deduct the costs of such inspection from the consignor's bill for such stock. This section shall be deemed to be a part of every contract made in this state for the sale of nursery stock to be shipped into this state.

Sec. 4389. Inspection of nurseries. Penalty. All nurseries or places where nursery stock is grown, sold, or offered for sale, shall be inspected at least once each year by the state entomologist or one of his deputies, and if no serious pests are found, a certificate to that effect may be given. If such pests are found, the owner shall take such measures to suppress the same as the state entomologist may prescribe. If such measures are not immediately taken by the owner of such nursery or place, such certificate shall be withheld, and every nurseryman who does not hold such a certificate, after the first annual inspection, who shall sell or otherwise dispose of nursery stock, shall be fined not more than fifty dollars. The form of certificate and the season for inspecting nurseries may be determined by the state entomologist. The state entomologist or any of his deputies may at all times enter any public or private grounds in the performance of his duty.

Sec. 4390. Appropriation. The sum of three thousand dollars is appropriated to carry out the provisions of Sections 4386, 4387, 4388, and 4389, which sum is to be paid quarterly to the treasurer of said station, who shall hold the same subject to the order of the state entomologist.

These amendments give the state entomologist discretionary power to cause the destruction or proper treatment of infested trees and shrubs, and if the owner refuses or neglects to act after having been duly ordered in writing by the state entomologist, he is subject to a fine of not more than fifty dollars.

It is also necessary that nursery stock shipped into the state shall bear a statement that it has been thoroughly fumigated in addition to the certificate of inspection issued by a state or government officer.

These amendments became operative July 1st, 1903.

A copy of the law, printed in circular form, was sent to nursery men of Connecticut and to inspectors of all other States during the summer.

ORGANIZATION, EQUIPMENT, ETC.

Assistance.—Throughout the year the State Entomologist has been assisted in office, field and laboratory by Mr. B. H. Walden, who has done most of the photographic work, and has aided in the preparation of a portion of this report. Mr. Austin Turner was employed for three months in late winter and early spring to assist in the spraying experiments. Mr. Henry L. Viereck, a well-known entomologist and specialist in the Hymenoptera, began work October 15th, rearranging the specimens in the collection and working up the undetermined material. These gentlemen have all performed their duties faithfully and acceptably.

Equipment.—The collection of insects has been increased considerably and is being transferred to Schmitt boxes, which are safer than the old cases. The Schmitt boxes will then be placed in metal cases, thus rendering the specimens doubly safe. Several glass-covered exhibition cases have been purchased and also a number of Riker mounts.

A "Hardie wheel outfit" consisting of a small barrel and pump mounted on wheels was bought for spraying trees and plants in the garden, and found to be convenient and satisfactory.

Exhibits.—Injurious insects, prepared insecticides, insecticide materials, spray pumps, nozzles, etc., have been shown at the annual meeting of the Connecticut Pomological Society at Hartford in February, and at the fruit exhibit of the same Society at Berlin in September; a similar exhibit was made at the annual meeting of the Connecticut Board of Agriculture at Middletown in December.

Library.—The entomological library has been enriched during the year by completing sets of the *Entomological News, Insect Life* and the Reports of the Ontario Entomological Society. Purchases have also been made of the Proceedings of the Entomological Society of Washington, Theobald's Monograph of the Culicidæ of the World, Green's Coccidæ of Ceylon, Newstead's Coccidæ of the British Isles, Wytsman's Genera Insectorum, and many special reports and monographs of one volume each.

CORRESPONDENCE.

This part of the work has increased considerably, 900 letters being written as against 679 in 1902. These are all on matters pertaining to work of the office, the identification of specimens and remedial treatment recommended forming a large portion.

The work of inspecting nurseries and orchards and conducting spraying experiments also makes correspondence necessary.

LECTURES AT MEETINGS.

The State Entomologist is occasionally called upon to give lectures at fruit grower's institutes, farmer's meetings, granges, etc. During the year of 1903 twelve such gatherings have been addressed upon subjects connected with insects. Four of the lectures were illustrated with lantern slides. The State Entomologist attended the meeting of Official Horticultural Inspectors at Washington, November 17th and 18th.

PUBLICATIONS.

The following publications have been issued from the entomological department during 1903:

POSTAL CARD BULLETIN (not numbered with the regular series) containing brief instructions regarding immediate work against the San José scale-insect and Elm leaf-beetle, was printed in an edition of 11,000 copies and mailed to residents of the state during February.

BULLETIN 142 (SPRAY CALENDAR) was prepared jointly by the entomologist and botanist, half of the expense being paid from the entomological fund. It was sent out in February. An edition of 12,000 copies was published and a few hundred only remain for distribution.

SECOND REPORT OF THE STATE ENTOMOLOGIST (PART II OF THE REPORT OF THE STATION) was printed in an edition of 12,000 copies and distributed in March. This report contains 80 pages, 19 figures and XV plates, and gives an account of all the insect work of the Station during the year of 1902.

BULLETIN 143, Two Common Scale-Insects of the Orchard (The Scurfy Bark-Louse. The Oyster-Shell Bark-Louse) containing 10 pages, 5 figures and II plates was distributed during May in an edition of 12,000 copies. This bulletin contained the chief facts connected with the life-histories of the insects, descriptions and illustrations that enable the orchardist to identify them, and recommendations for remedial treatment. It was sent out shortly before the proper time to spray against these scale-insects.

BULLETIN 144, Fighting the San José Scale-Insect in 1903, 26 pages, III plates, gives an account of the season's experiments in spraying to kill this pest. Twelve thousand copies were printed and distributed in November.

CIRCULARS containing the text of the amended Insect Pest law were printed and sent to nurserymen in Connecticut, and to officers having charge of nursery inspection work in other states. Instructions regarding the use of the certificate were also issued to the nurserymen.

With the exception of Bulletin 142, and the Second Report of the State Entomologist, the above-named publications are reproduced in this Report in slightly emended form.

INSPECTION OF NURSERIES.

The nurseries of the state were inspected by the State Entomologist and his assistant, Mr. Walden. The work was commenced about the middle of September and nearly finished by November 1st, six weeks being required to do this work, in addition to the other necessary work of the entomologist's office.

The number and date of each certificate granted, as well as the names of the nursery firms receiving them, are given below:

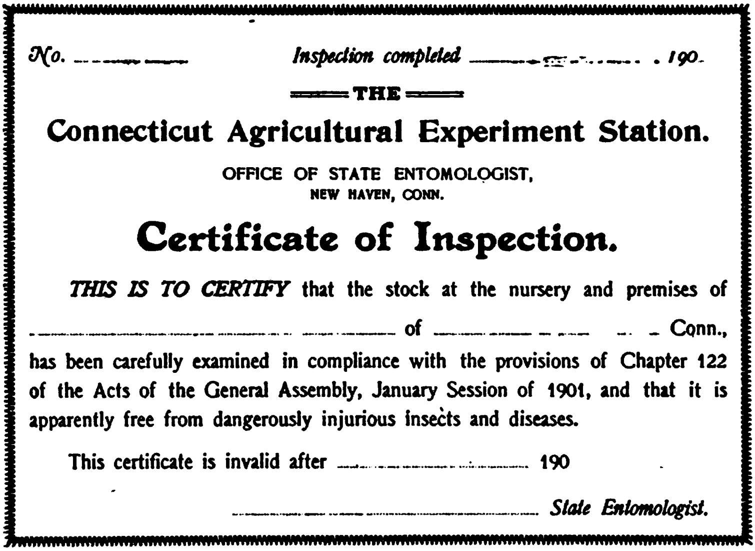
LIST OF NURSERY FIRMS RECEIVING CERTIFICATES IN 1903.

Name of Firm.	Location.	Inspection Finished.	Certificate Number.
Allen, Chas I.	Terryville	Nov. 4	132
Atwater, C. W.	Collinsville	Sept. 21	107
Barnes Bros.	Yalesville	Oct. 23	126
Beers, S. Perry	Greenfield Hill	Nov. 12	134
Bishop, J. N.	Plainville	Oct. 23	125
Bowditch, J. H.	Pomfret Center	Oct. 29	128
Bridgeport Nursery	Bridgeport	Dec. 31	139
Burr & Co., C. R. (2)	Manchester	Oct. 2	112
Butler & Jewell Co., The	Cromwell	Oct. 13	118
Comstock & Lyon	Norwalk	Oct. 14	119
Conine, F. E.	Stratford	Sept. 26	110
Conn. Agricultural College	Storrs	Oct. 22	123
Conn. Valley Orchard Co.	Berlin	Oct. 30	129
Conway, W. B.	New Haven	Oct. 2	116
Dehn & Bertolf	Greenwich	Oct. 8	120
East Rock Park Nursery	New Haven	Sept. 18	106
Elizabeth Park Nursery	Hartford	Sept. 21	108
Elm City Nursery Co.	New Haven	Sept. 25	109
Gardner's Nurseries	Cromwell	Oct. 13	117
Gurney & Co., H. H.	New Canaan	Oct. 5	114
Hale, J. H.	So. Glastonbury	Oct. 20	121
Holcomb, Irving (2)	West Granby	Dec. 22	137
Hoyt's Sons Co., Stephen	New Canaan	Oct. 5	115
Hunt & Co., W. W.	Hartford	Oct. 28	127
Jackson, B. A.	So. Norwalk	Nov. 25	135
Keney Park Nursery (2)	Hartford	Nov. 3	131
Longden, C. E.	North Haven	Sept. 15	105
Norton, A. F.	New Britain	Oct. 23	124
Pierson, A. N.	Cromwell	Oct. 3	111
Platt Co., The Frank S.	New Haven	Dec. 30	138
Purinton, C. O.	Hartford	Dec. 2	136
Ryther, O. E.	Norwich	Oct. 26	133
Smith Co., The H. C.	New Haven	April 8	103
Veitch Co., The Robert	New Haven	Oct. 31	130
Vidbourne & Co., J.	Hartford	Oct. 15	122
Wallace, W. E.	Hartford	Oct. 3	113

It will be noticed that the nurserymen's list contains thirty-six names. Last year there were thirty-one names upon the list. Two of these firms have gone out of business and seven other names have been added. Three of these nurseries were inspected last year, but their owners did not get them cleaned up in time to receive certificates during the year of 1902; hence the names did not appear on the list.

Of these thirty-six nurseries, three were inspected twice and given certificates, thirty-nine certificates being issued during the year. At least four of the other nurseries were inspected twice, making in all forty-three nursery inspections for the year.

The form of the regular certificate granted to nurserymen is the same as was used in 1902, a facsimile of which is here reproduced.



No. ________ *Inspection completed* ____________ *190*

THE

Connecticut Agricultural Experiment Station.

OFFICE OF STATE ENTOMOLOGIST,
NEW HAVEN, CONN.

Certificate of Inspection.

THIS IS TO CERTIFY that the stock at the nursery and premises of ____________________ of ____________ Conn., has been carefully examined in compliance with the provisions of Chapter 122 of the Acts of the General Assembly, January Session of 1901, and that it is apparently free from dangerously injurious insects and diseases.

This certificate is invalid after ____________ 190

____________________ *State Entomologist.*

In addition to the regular inspection of nurseries as prescribed by the laws of the state, the entomologist is occasionally called upon to inspect stock intended for shipment by some person who is not in the nursery business. For instance, one person wished to send choice plants from his garden to a friend outside of Connecticut: a man who acted merely as a distributing agent for a New York nursery, wished to return surplus stock to the nursery. In each case the transportation company refused to carry the goods unless accompanied by certificates of inspection. Two certificates, which I have called emergency certificates, were issued during the season to accommodate occasional shippers of nursery stock.

The emergency certificate just mentioned was made to apply only to the stock in the bale, package or box to which it was affixed. In other respects it was similar in form to, though distinct from, the regular nurserymen's certificate.

A copy of the following notice was given with each regular certificate:—

NOTICE TO NURSERYMEN AND SHIPPERS,

Regarding the Use of the Certificate.

The original nursery certificate issued by the State Entomologist under Section 4389 of the General Statutes is to be kept in your possession, and is not to be attached to any package of nursery stock. It applies to the whole nursery which has been inspected and to such purchased stock as has been received from other nurseries under the certificate of a state or government officer. Any stock received from outside the state unaccompanied by such a certificate is not allowed to be sent out until it has been duly inspected.

An exact transcript of the certificate may be printed on labels or tags for shipping and attached to each package sent out of the state, especially in such states as require it. An additional statement, made by the owner, that the stock has been fumigated will be required in many states. The law does not require that the inspection certificate be attached to every package shipped to points within the State of Connecticut, but it should accompany each box or package when convenient as it serves to call attention to the provision of the law.

The number, date, and in fact each word of the certificate must be printed on the shipping tags. Any omission will be looked upon as an abuse of the certificate and may lead to its being revoked by the State Entomologist.

Emergency certificates, to be used by persons wishing to ship a few trees or shrubs and who are not engaged in a regular nursery business, will be issued after an inspection has been made upon request. Such certificates apply only to the contents of the packages upon which they are placed.

After the date of expiration, which is a part of each certificate, the document becomes invalid and should not be attached to any box, bale or package.

W. E. BRITTON,
State Entomologist.

CONDITION OF NURSERIES IN 1903.

On the whole the nurseries were in about the same condition in 1903 as in 1902. In ten nurseries the San José scale was not found, while twenty-six were found to be infested—some only slightly, others seriously. A few nurserymen informed the writer that they knew that the scale was present on their grounds, but that they had been too busy to give the matter any attention. How anyone can ignore this insect and allow it to multiply unchecked, especially where the stock must be inspected by state authorities, and where it may mean a loss of several hundreds of dollars in the destruction of stock, is quite incomprehensible. Several Connecticut nurserymen have been careless in this respect and considerable stock had to be destroyed on account of the owner's neglect. It is a case of "live and learn," though it would be far cheaper to follow advice than to gain the knowledge by any such experience. Most of the nurserymen of the state are extremely anxious to have their stock as clean as possible, and go to considerable expense to keep it so.

Of the infested nurseries, seven were found in worse condition, and ten in better shape than last year, in regard to the degree of infestation.

Wherever infested stock has been found in nurseries it has been destroyed, and in case of the larger nurseries, the remaining stock of fruit trees and deciduous trees and shrubs that are subject to attack by the scale have been fumigated with hydrocyanic acid gas.

Nurseries have somewhat increased in acreage during the year and probably now have a total area of about 500 acres.

There is a decided tendency among the smaller nurserymen to keep on hand a larger stock of those trees and shrubs not attacked by the scale and to buy each year from the large nurseries, as needed, their fruit trees and other stock that is especially liable to infestation.

It seems to the writer that the use of varieties of plants which the scale does not attack should be encouraged as much as possible in landscape and ornamental planting. Landscape gardeners and nurserymen have an excellent opportunity to point out the desirable and undesirable features of plants in this respect.

Fumigation of Nursery Stock.

The desirability of fumigation laws has been discussed in nearly all the states of the Union and in many cases such laws have been enacted. Fumigation is not an infallible remedial treatment for the San José scale, as in several cases insects have come through it alive, but if properly conducted it is the surest method that we can at present recommend for destroying the scale and saving the trees. The expense is not great in the larger nurseries where a proper outfit is installed for the purpose. Eight of the larger nurseries are now provided with regular fumigating houses and several more are now being built. The entomologist and his assistants try to encourage this as much as possible and give advice and information regarding the proper method of construction and operation.

It is not improbable that a compulsory fumigation law may soon be passed in Connecticut. It should be considered carefully, however, and not prepared in haste. Many such laws provide for the fumigation of all nursery stock without explaining what is meant by the term "nursery stock." In the writer's opinion it is quite unnecessary to fumigate herbaceous plants and conifers. All fruit stock, and such other deciduous trees and shrubs as are attacked by the scale, should be fumigated. The law should either distinctly specify what kinds are to be fumigated or it should be left to the discretion of the officer in charge of the work.

Florists who ship living plants and especially such shrubby plants as azaleas, roses, etc., occasionally complain that their shipments have been refused by transportation companies or "held up" by inspection officers because not accompanied by a certificate. Now most of the laws concerning the subject expressly exclude greenhouse plants from the need of fumigation, and if florists would attach a tag or label reading, "Greenhouse plants" to every package shipped, this trouble would probably be avoided.

Examinations of Orchards, Gardens, Etc.

Twenty-five orchards, gardens, greenhouses, etc., have been examined during the year to see if insect pests were present.

Most of these examinations were made at the request of the owner, a few at the request of interested parties. The entomologist has also made several examinations on his own account.

SCALE-INFESTED LOCALITIES.

Fifty-six infested localities have been discovered during the year, making in all two hundred and twenty-one, including nurseries. The San José scale is now known to exist in every county in Connecticut, and it will probably be only a short time when there will be no region that is not infested.

MOSQUITO INVESTIGATIONS.

On account of a pressure of other work, very little time could be devoted to mosquito investigations. Nevertheless, some collecting and breeding was done, and a portion of the region about New Haven was explored for the natural breeding places of mosquitoes. We have already taken thirteen species in the state. This important work will be continued and a careful survey made of the principal breeding places. The State Entomologist will be glad to hear from any localities where an organized effort is being made to prevent the breeding of mosquitoes, and will, if possible, institute an investigation of the local conditions and give advice as to the best method of treatment.

STUDY OF TOBACCO INSECTS.

It was planned to make a somewhat extensive study of the insects attacking the tobacco plant in Connecticut during the season and many visits were made to the fields during the summer. Very few insects were collected, however, and tobacco growers assert that the crop of 1903 has been unusually free from insect attack. It will be necessary, therefore, to continue the observations for one or more seasons before we can hope to publish anything about Connecticut tobacco insects.

GENERAL INSECT REVIEW.

Meteorological conditions.—The weather conditions of 1903 were somewhat unusual and it is customary to ascribe the extraordinary prevalence or absence of insects to the effect of the weather either upon the noxious species or upon their parasites. During the early part of December, 1903, the temperature was high and the ground bare and not frozen. About the eighth, there was a light fall of snow with a sudden drop in the temperature. The minimum temperature of the winter was recorded on the morning of the ninth when the mercury went far below zero, varying of course in different localities. The effect was very disastrous to many fruit trees in which the sap had been moving only a few days before. Blossom buds were killed generally in the Connecticut peach orchards, and in some nurseries peach and even apple trees were greatly injured, as shown by a curious discoloration of the wood and failure to make a satisfactory growth afterwards. Though there were other spells of cold weather during the winter, to this December freeze can be attributed most of the injury to trees.

There was considerable speculation regarding the effect of this sudden freeze upon insect life and especially upon the San José scale. In making a careful examination of thousands of these insects, in connection with our spraying experiments to kill them, from one hundred and twenty trees in four different localities of the state, the average mortality of San José scale-insects was found to be 27.6 per cent. Our record of the previous year from three localities shows a mortality of 35.6 per cent. from thirty-seven trees, while in 1901, from twenty-two trees in three localities, we obtained a mortality record of 14 per cent. The normal effect of the winter kills probably not far from 25 per cent. of the scales. The winter of 1902-1903 was not then an abnormally disastrous one so far as killing the San José scale is concerned. Further proof is found in the rapidity with which this insect multiplied during the summer.

The chief characteristic of the summer of 1903 was the severe drought during the latter part of April and extending through the month of May, at a time when all kinds of vegetation should be making the most rapid growth. While there was no lack of moisture during the remaining months of the summer, the season was characterized by its coolness, there being few hot days.

Abundance of Plant-lice.—The dry weather of spring seemed to be favorable to the rapid multiplication of many kinds of plant-lice, which were generally very abundant. The apple-leaf aphis, which is described in another part of this Report, proved a serious pest. Cherry, plum and currant lice were present on their respective host-plants, and shade-trees in many places were fairly dripping with the sweet "honey dew" exuded by the plant-lice that were sucking sap from their leaves. Even the weeds of the garden and roadside, as well as the ornamental and useful cultivated plants, were the subjects of similar attack. Later in summer, when rains were frequent, a fungus, or "sooty mold" grew in the "honey dew," giving a black and scorched appearance to trees and plants.

The green pea louse (*Nectarophora pisi* Kalt.) was less abundant than during the previous season. It has been on the decrease since 1900, and while late peas may be injured in some cases, in others it has not been found necessary to apply any remedial treatment. The pear psylla (*Psylla pyricola*) was a scourge to most of the pear trees of this vicinity, and as specimens were received from different parts of the state it was probably not less severe elsewhere. A separate account of this insect is given on another page of this Report.

Scale-Insects.—Reports from fruit growers in various parts of the state show that the San José scale-insect has multiplied very rapidly in infested orchards. The same may perhaps be said of some other kinds of scale-insects. The apricot scale (*Eulecanium armeniacum* Craw.) is becoming quite common in Connecticut, and has been found on grape, rose, chestnut; and white ash trees in the woodlands of Windsor were quite badly infested. This species has also been received from West Cornwall on white ash. It is known to attack all kinds of fruit trees.

Tent-caterpillar and Fall Web-worm.—These insects were perhaps less abundant than in 1902, yet they did much injury to fruit and shade trees. The eggs of the tent-caterpillar hatched very early and in some localities the nests were much in evidence. Mr. J. M. Whittlesey of Morris writes that in his vicinity nests were more abundant than he has ever seen them before, but that nearly all of the caterpillars died before reaching maturity.

The cause of their death was not learned but was doubtless one of the parasites or natural enemies of the tent-caterpillar—possibly the bacterial disease.

During August and September the nests of the fall web-worm were a part of nearly every landscape view though less abundant than in 1901 and 1902.

Scarcity of Potato Beetles.—The Colorado potato beetle was less abundant than for many years, and in some potato fields poisoning was unnecessary. The writer cannot remember a year, since the beetle came into New England, when potato fields have suffered so little injury as during the past season. Not only was this true of Connecticut, but in southern New Hampshire, where the writer stayed during August, the reports were similar.

Elm Leaf-Beetle also less abundant.—Much less damage was done to the elm trees of New Haven and near-by cities and towns than for several years.

Hickory Bark-Borer.—This destructive insect seems also to be on the wane in New Haven. Some trees had to be removed from the attacks of last year, but evidently much less damage was done to new trees than for two years. (See Reports for 1901, p. 267, and for 1902, p. 169.)

The tobacco crop throughout the state was almost free from insect attack, the tobacco worm being very scarce.

It is difficult to account for the decreased activity of the insects just mentioned. Possibly the winter, possibly predaceous and parasitic enemies may be responsible for it. It is well known, however, that most native species of insects fluctuate considerably in abundance, and when numerous for one or more seasons, a period of decrease follows.

Other Insects.—Mention was made in my last Report (Report for 1902, page 174) of the presence in Connecticut of the twelve-spotted asparagus beetle (*Crioceris 12-punctata* Linn.). Several more specimens were this year taken at New Haven, and we may from now on regard this as one of the injurious species of the state.

The onion thrips (*Thrips tabaci* Linde.) destroyed a three acre field of onions near New Haven in July. The writer saw the field on July 24th and advised treatment, but the injury had then been done and the owner decided to plow the field and put in some other crop. A short account of this insect is given on another page of this Report.

Lady Beetles were abundant all through the season, and the plant lice upon which they prey certainly gave them food in abundance.

Two New Beneficial Insects.—On February 1, 1902, a curious object was received from a nursery in Westville, near New Haven, found upon *Ilex crenata,* which had been imported from Japan the previous spring. This proved to be the egg-case of an orthopterous insect of Asia, *Paratenodera sinensis* Saus.

Paratenodera belongs to the *Mantidæ*, and feeds upon other insects, especially plant lice, grasshoppers and caterpillars. During the summer of 1903 another of these egg-cases was found in the same nursery, indicating that the insect had already partially established itself in Connecticut. As the same insect has become thoroughly established in a similar way near Philadelphia, it is quite probable that the egg-masses were imported directly from Japan with the shrubs. A number of these egg-cases have just been procured from Philadelphia, through the kindness of a friend, and these will be placed out of doors at the proper time and the results watched with interest.

Another insect that is likely to prove beneficial is the European Praying Mantis, *Mantis religiosa* Linn., which was accidentally introduced into the state of New York a few years ago. An account of this insect was given by Professor M. V. Slingerland in Bulletin 185, of the Cornell Experiment Station. The European Praying Mantis feeds upon living insects, including grasshoppers, flies, etc. Several egg-masses have been procured from Central New York and these will also be placed outside where we can watch them. Both *Mantis religiosa* and *Paratenodera sinensis* have a striking appearance and if they become established in Connecticut we will have more to say about them later.

Chinese Lady-Beetle.—Though application for some of these beetles was made over two years ago, we have not yet been able to obtain any specimens for Connecticut. Beetles have been furnished, however, to some of the other states, and it is hoped that they may increase sufficiently, so that a few may be spared for Connecticut during the coming season.

Periodical Cicada not observed.—A brood of the periodical cicada or seventeen-year locust was expected to appear in Connecticut during 1903, but though we were on the lookout, were not able to find specimens or any indications that the brood appeared. Several correspondents were notified to be on the watch and to report as soon as the species was observed. So far as this office is concerned, we have no records of this brood, though it is reported from Rhode Island.

The more important injurious insects of the season mentioned in the foregoing pages, are treated more fully elsewhere in the following pages of this Report.

Identification of Insects.

A good deal of time is required for naming the insect specimens sent by correspondents. If the specimen is a common species very little trouble or time is necessary to identify it. But not infrequently a half-day or one or more entire days are spent in determining a single specimen, and then it is sometimes necessary to send it to a specialist in the particular group or family to which it belongs in order to make sure of its identity. Nevertheless, the work is of such importance that it cannot be dropped or neglected, for it is a guide to the prevalence of species during the season and it is of direct service to the farmers and plant growers of the state.

During the calendar year, 185 samples of insects and other forms of animal life have been received for identification.

For the identification of species unknown to the writer he is indebted to the following entomologists who have kindly examined material from the collection:—Dr. L. O. Howard, Washington, D. C.; Mr. Geo. B. King, Lawrence, Mass.; Mr. E. P. Van Duzee, Buffalo, N. Y.; Mr. C. W. Johnson, Boston, Mass., and Mr. Henry L. Viereck.

Following is a list of such specimens so far as they can be determined:—

INSECTS AND OTHER ANIMALS RECEIVED FOR IDENTIFICATION.

DATE.	NAME.	HOST.	LOCALITY.	REMARKS.
Jan. 26	Tulip Tree Scale, *Eulecanium tulipiferæ* Cook	*Liriodendron*	New Haven	On young street tree in northern part of city.
" 28	San José Scale, *Aspidiotus perniciosus* Comst.	Elm	Hartford	Badly infested.
Feb. 3	Tulip Tree Scale, *Eulecanium tulipiferæ* Cook	*Liriodendron*	Middletown	Lower branches of tree infested.
" 11	Scurfy Bark-Louse, *Chionaspis furfurus* Fitch	Apple	Glastonbury	Egg stage.
" 16	" " " "	Pear	Cannon Station	"
" 19	Brown Aphis of violet, *Rhophalosiphum violæ* Pergande	Violet	New Haven	All dead: had been fumigated with hydrocyanic acid gas.
	Red Spider, *Tetranychus telarius* L.	"	"	These were subjected to same treatment as preceding, but were not all killed.
" 20	San José Scale, *Aspidiotus perniciosus* Comst.	Apple	Milford	Had been sprayed with kerosene.
	" " "	Peach		No address accompanied the specimens.
" 21	White-fly, *Aleyrodes vaporariorum* Westw.	Tomato	Pomfret	Sent by request.
" 26	San José Scale, *Aspidiotus perniciosus* Comst.	Pear, Apple	Greens Farms	Twigs well covered.
Mar. 10	" " "	Pear, Currant	Southington	" " "
	Oyster-shell Bark-Louse, *Mytilaspis pomorum* Bouché	Apple	"	Moderately infested.
	Green Apple Aphis, *Aphis pomi* DeG.	"	North Grosvenordale	Egg stage. A few eggs glued around the buds.
" 12	Oyster-shell Bark-Louse, *Mytilaspis pomorum* Bouché	Lilac	Bridgeport	Egg stage.
" 16	Scurfy Bark-Louse, *Chionaspis furfurus* Fitch	Currant	New Haven	"
	San José Scale, *Aspidiotus perniciosus* Comst.	Quince	"	Branch thoroughly encrusted.
" 17	" " "	Apple, Plum, Currant	Bridgeport	" " "
" 25	" " "	Pear	Shelton	" " "
	Scurfy Bark-Louse, *Chionaspis furfurus* Fitch	Currant	Hockanum	Egg stage.
" 27	San José Scale, *Aspidiotus perniciosus* Comst.		Meriden	
" 28	" " "	Apple, Pear, Plum	New Haven	Badly infested.
	Green Apple Aphis, *Aphis pomi* DeG.	Apple	Orange	Black eggs around the buds.

INSECTS AND OTHER ANIMALS RECEIVED FOR IDENTIFICATION—*Continued.*

DATE.	NAME.	HOST.	LOCALITY.	REMARKS.
Mar. 31	Oyster-shell Bark-Louse, *Mytilaspis pomorum* Bouché	Lilac	Meriden	Empty shells.
	San José Scale, *Aspidiotus perniciosus* Comst.	Apple, Peach, Plum	"	Twigs badly infested.
April 6	" " "	Currant	Bridgeport	" " "
" 7	Apple-Tree Tent-Caterpillar, *Clisiocampa americana* Harris	Lilac	Hartford	Young larvæ hatched April 5th.
	Microgaster fly ——	Pandorus or achemon caterpillar	"	Cocoons of hymenopterous parasite.
" 8	San José Scale, *Aspidiotus perniciosus* Comst.	Peach	East Norwalk	Dead twig thoroughly covered.
" 14	" " "	Apple, Pear	Seymour	Sections of bark well infested.
" 17	" " "	Plum	Hawleyville	Twigs badly infested.
" 18	" " "	Apple	Southington	A few specimens on twig.
	Woolly Aphis, *Schizoneura lanigera* Hausm.	"	"	Aphids clustered in open wounds of bark.
" 22	Spotted Lady Beetle, *Megilla maculata* DeG.		Norwalk	Found resting at base of tree.
	Squash Beetle, *Epilachna borealis* Fabr.		"	" " " "
	San José Scale, *Aspidiotus perniciosus* Comst.	Apple	New Haven	Twigs badly infested.
	Rose Scale, *Aulacaspis rosæ* Bouché	Rose	Plantsville	A few specimens on same canes as following.
	Hymenopterous galls ——	"	"	Galls of a hymenopterous insect at base of lateral branches.
" 23	San José Scale, *Aspidiotus perniciosus* Comst	Pear	Meriden	A few specimens on twigs.
	Scurfy Bark-Louse, *Chinaspis furfurus* Fitch	"	"	Egg stage. On same twigs as preceding.
" 24	Green Apple Aphis, *Aphis pomi* DeG.	Apple	North Haven	Eggs and shells on twigs around buds.
" 27	Peach Borer, *Sanninoidea exitiosa* Say.	Peach	Chapinville	Larvæ from base of trees.
	Fungus gnats ——?	"	"	Mycetophilous larvæ in gregarious masses in gum at base of trees.
" 27	Oyster-shell Bark-Louse, *Mytilaspis pomorum* Bouché	Black Walnut	New Britain	Dead branch covered with dead scales.
May 1	Katydid eggs ——?	Cedar	New Haven	Eggs laid on twigs.

INSECTS AND OTHER ANIMALS RECEIVED FOR IDENTIFICATION—*Continued.*

DATE.		NAME.	HOST.	LOCALITY.	REMARKS.
May	9	Myriapod, *Spirobolus marginatus* Say.	Black Walnut	Middletown	Found in dead roots and soil.
		Oak Scale, *Asterolecanium variolosum* Ratz.	Oak	Hartford	On scarlet oak in city park.
"	13	Clothes Moth, *Tinea sp.?*	Clothing	New Haven	Adults from closet.
"	14	Virgin Moth, *Spilosoma virginica* Fabr.		Hamden	Adult.
		Woolly Aphis, probably *Phyllaphis fagi* L.	Purple Beech	New Haven	A few specimens on leaf.
"	15	Orthezia, *Orthezia insignis* Dougl.	Lantana	"	On plants in greenhouse.
"	19	Elm Leaf-Beetle, *Galerucella luteola* Müll.	House	So. Canterbury	Found on window in attic.
		Aphis ——?	Plum	"	Aphis on leaves. Had been sprayed with kerosene emulsion.
"	25	Tulip Tree Scale, *Eulecanium tulipiferæ* Cook	*Liriodendron*	Hamden	Partially grown males on twig.
		Luna Moth, *Actias luna* L.		Farmington	Female. Laid a mass of eggs.
		Strawberry Saw-fly, *Harpiphorus maculatus* Norton	Strawberry	Cromwell	Larvæ feeding on Strawberry leaves.
"	28	——*Acanthia hirundinis* Jenyns.	House	Mt. Carmel	Found about chimney over fireplace.
		Oyster-shell Bark-Louse, *Mytilaspis pomorum* Bouché	Ash	West Cornwall	Branch well covered. Eggs have hatched and young are crawling.
		Apricot Scale, *Eulecanium armeniacum* Craw.	"	"	Branch well infested. Egg stage.
		Hickory Stem Gall-Louse, *Phylloxera caryæcaulis* Fitch	Hickory	Stockbridge, Mass.	Forming galls on leaf-stems and blossoms. Females and eggs inside the galls.
		——	Linden	New Haven	Galls on upper surface of leaf. No insects could be found.
June	1	Oyster-shell Bark-Louse, *Mytilaspis pomorum* Bouché	Lilac	Hartford	Eggs had hatched and young had established themselves.
"	2	Elm Scale, *Gossyparia spuria* Mod. (*ulmi*)	Elm	Southington	A few specimens on twigs.
		Elm Leaf-Beetle, *Galerucella luteola* Müll.	"	"	Bunch of eggs on leaf.
		——	"	Middletown	
		Aphis ——	Maple	"	On leaves.
"	3	Eyed Elater, *Alaus oculatus* Linn.		Forestville	
		Woolly Aphis, probably *Phyllaphis fagi* L.	Beech	Stratford	Leaves well infested.
		Aphis	Cut-leaved Birch	"	Leaves infested.

INSECTS AND OTHER ANIMALS RECEIVED FOR IDENTIFICATION—*Continued.*

DATE.	NAME.	HOST.	LOCALITY.	REMARKS.
June 3	Aphis	Lima Beans	Shelton	A few specimens on leaf.
" 4	"	Norway Maple	New Canaan	On under side of leaves which were covered with honey dew.
" 5	Woolly Aphis, *Pemphigus tessellata* Fitch	Alder	Southbury	On leaves and twigs.
	Alder Mite, *Phytoptus* ——?	"	"	Forming galls on upper surface of leaf.
	Hackberry Leaf Gall-Louse, *Pachypsylla celtidis-mamma* Riley	Hackberry	New Haven	Forming galls on under surface of leaves.
	Spiny Elm Caterpillar, *Vanessa antiopa* L.	Elm	Middlebury	Devouring leaves of the elm tree.
" 8	Hickory Stem Gall-Louse, *Phylloxera caryæcaulis* Fitch	Hickory	New Preston	Galls on leaf-stems filled with young lice.
	Apricot Scale, *Eulecanium armeniacum* Craw.	Chestnut	Waterville	Egg stage: brown hemispherical scale-insect on bark of twigs.
" 10	" " "	Rose	Windsorville	Egg stage: twig covered.
	Promethea Moth, *Attacus promethea* Dru.		New Haven	Female adult.
" 12	Glow Worm, *Phengodes laticollis* Lec.?		Mt. Carmel	Apparently an adult female resembling a larva. Luminous and very handsome.
" 14	——		New Haven	Larvæ found in park.
	Rose Scale, *Aulacaspis rosæ* Bouché	Rose	"	A few specimens on bark of twig.
	Dragon-fly, *Epiæschna heros* Fabr.		"	
" 15	Apricot Scale, *Eulecanium armeniacum* Craw.	Rose	Windsorville	More material sent at my request.
" 18	Green Apple Aphis, *Aphis pomi* DeG.	Apple	Mt. Carmel	On under surface of leaves.
	" " ——?	*Lonicera sempervirens*	"	On leaves.
" 20	Tortoise Beetle, *Coptocycla clavata* Fabr.	Potato	Cheshire	Devouring leaves.
	Four-lined Leaf-Bug, *Pœcilocapsus lineatus* Fabr.	"	"	Sucking sap from the leaves.
	Striped Squash Beetle, *Diabrotica vittata* Fabr.	Potato, Squash	Cheshire	Devouring leaves.
" 23	Woolly Elm Aphis, *Schizoneura americana* Riley	Elm	Norwich	On under surface, causing leaves to roll, forming pseudo-galls.
	Black Long Sting, *Thalessa atrata* Fabr.		New Haven	Female with long ovipostor.

INSECTS AND OTHER ANIMALS RECEIVED FOR IDENTIFICATION—*Continued.*

DATE.	NAME.	HOST.	LOCALITY.	REMARKS.
June 25	Cherry Aphis, *Myzus cerasi* Fabr.	Cherry	Guilford	Leaves curled. Black aphis.
	Currant Fruit Worm	Currant	East Norwalk	Infesting berries of Fay's Prolific variety.
" 27	Green Apple Aphis, *Aphis pomi* DeG.?	Apple	Glastonbury	Too badly crushed for specific identification.
	Currant Aphis, *Myzus ribis* L.?	Currant	"	
	Cherry Aphis, *Myzus cerasi* Fabr.?	Cherry	"	
	Green Apple Aphis, *Aphis pomi* DeG.?	Apple	Cannon Station	
" 30	" " " "	"	Windsor Locks	Young twigs covered with green lice.
	——— *Hamamelistes spinosus* Shimer	White Birch	New Haven	On birch leaves, killing them.
July 1	Rudbeckia Aphis, *Nectarophora rudbeckiæ* Fitch	*Rudbeckia* Golden Glow	"	Red aphis on stalks.
	Strawberry Leaf-Roller, *Ancylis comptana* Frœl.	Dewberry	Highwood	Quite abundant in field of Lucretia dewberries.
	Fruit Bark Beetle, *Scolytus rugulosus* Ratz.	Japan Plum	Hamden	Seriously injuring trees.
" 3	Currant Fruit Worm, ———	Currant	Norwalk	Infesting berries.
" 7	Aphis, *Nectorophora sp.?*	Potato	Fairfield	Very abundant on leaves and stems.
	Pear Psylla, *Psylla pyricola* Först.	Pear	Hartford	Causing leaves to fall. Honey dew and insects abundant.
" 9	Unicorn Caterpillar, *Schizura unicornis* S. & A.	Apple	Shelton	Partially grown larva devouring leaves.
	Maple Aphis, *Chaitophorus sp.?*	Norway Maple	East Norwalk	Infesting leaves. Honey dew abundant.
" 10	Aphis ———	Hop	Westville	Black lice on leaves.
	Lady Beetle, ———?	"	"	Larvæ feeding upon the plant lice.
	Glow Worm, *Phengodes sp.?*		Waterbury	Appears to be a larva. 1 inch long. Found in grass under maple trees.
" 14	Twice-stabbed Lady Beetle, *Chilocorus bivulnerus* Muls.	Apple	Bloomfield	Pupæ and larval skins present.
	Pear Psylla, *Psylla pyricola* Först.	Pear	Portland	Fruit and leaves badly infested.
" 15	Work of Flea-Beetle, ———?	Potato	Bristol	Leaves perforated.
" 16	Pear Psylla, *Psylla pyricola* Först.	Pear	Seymour	Leaves badly infested and falling.
	Apricot Scale, *Eulecanium armeniacum* Craw.	Japan Plum	"	Twig covered by old shells. Young crawling.

INSECTS AND OTHER ANIMALS RECEIVED FOR IDENTIFICATION—*Continued.*

DATE.		NAME.	HOST.	LOCALITY.	REMARKS.
July	17	Green Apple Aphis, *Aphis pomi* DeG.	Apple	West Haven	Specimen crushed.
"	18	Maple Borer, *Plagionotus speciosus* Say.	Maple	New Haven	Adult and larvæ of different sizes.
		——— *Alaria florida* Gn.		"	Found in building.
		Pear Psylla, *Psylla pyricola* Först.	Pear	Hamden	On twigs of new growth causing leaves to curl.
"	20	Senator Moth, *Anisota senatoria* S. & A.		New Haven	Adult found in raspberry patch.
"	23	Apple-Tree Tent-Caterpillar, *Clisiocampa americana* Harris	Peach	Lyme	Egg-mass on twig.
"	29	Long-horned Beetle, *Romaleum atromarium* Dru.		New Haven	Adult crawling under oak tree.
"	31	Green Apple Aphis, *Aphis pomi* DeG.	Apple	Cheshire	On under surface of leaves.
		Lesser Prionus, *Orthosoma brunneum* Först.		New Haven	Crawling in dwelling house.
		——— *Chrysochus auratus* Fabr.		West Haven	Single adult specimen.
		Mexican Jumping Seeds, ———?	*Euphorbia*	Mexico	Larva inside of each locule.
Aug.	1	Lesser Prionus, *Orthosoma brunneum* Först.		New Haven	
"	4	Pear Psylla, *Psylla pyricola* Först.	Pear	West Granby	On leaves and twigs.
"	6	" " "	"	Woodbury	" "
"	8	Celery Butterfly, *Papilio polyxenes* (*asterias*) Fabr.		New Haven	Male and female adults.
"	12	Chain-dotted Geometer, *Cingilia catenaria* Dru.	Sweet Fern	Terryville	Yellow and black larvæ feeding on various low growing shrubs.
"	14	Peach Borer, *Sanninoidea exitiosa* Say.	Peach	Hartford	
		Robber Fly, *Erax bastardi* Macq.		"	
"	17	Saddle-back Caterpillar, *Sibine stimulea* Clem.	Corn	Hamden	
"	22	Assassin Bug, *Acholla multispinosa* DeG.	Apple	Warehouse Point	Found crawling on trees.
"	24	San José Scale, *Aspidiotus perniciosus* Comst.	Plum	Rockville	Badly infested.
"	25	Saddle-back Caterpillar *Sibine stimulea* Clem.		New Haven	
"	28	Dog-day Harvest-fly, *Cicada tibicen* Linn.		Windsor	Found in cellar of dwelling.
"	29	Fruit Bark-Beetle, *Scolytus rugulosus* Ratz.	Plum	Cheshire	
		Hymenopterous insects ———		"	Evidently parasites upon preceding.
"	31	———	Hickory	New Haven	Larva found in twigs where adult *Scolytus quadrispinosus* occurred.

INSECTS AND OTHER ANIMALS RECEIVED FOR IDENTIFICATION—*Continued.*

DATE.	NAME.	HOST.	LOCALITY.	REMARKS.
Sept. 5	Pine Aphis, *Lachnus strobi* Fitch	Pine	Springdale	Twigs and leaves covered with sooty fungus growing in the honey dew.
	White Scale, *Chionaspis americana* Johns	Elm	Hartford	Supposed to have killed the branches.
“ 8	Scurfy Bark-Louse, *Chionaspis furfurus* Fitch	Apple	Higganum	Both sexes present.
	Green Apple Aphis, *Aphis pomi* DeG.	“	“	Cast skins and parasitized aphids on under surface of leaf.
	San José Scale, *Aspidiotus perniciosus* Comst.	Japan Plum	“	A few specimens on twigs.
	Work of Fruit Bark Beetle, *Scolytus rugulosus* Ratz.	“	“	Small holes in bark of twigs.
	Checkered Tussock Caterpillar, *Halisidota tessellaris* S. & A.		New Haven	Larva crawling about buildings.
“ 10	Spruce Bud-Louse, *Chermaphis abietis* L.?	Spruce	“	Empty galls made in spring.
“ 14	San José Scale, *Aspidiotus perniciosus* Comst.	Currant, Apple	Portland	Twigs well infested. Young crawling.
	Scurfy Bark-Louse, *Chionaspis furfurus* Fitch	Apple	“	Mostly males present.
	Locust Borer, *Cyllene robiniæ* Först.	Locust	New Haven	Male and female collected on locust tree.
	Brown Beetle, *Xyleborus celsus* Eich.	Hickory	“	Boring in wood of trunk.
“ 21	Plant Louse, *Lachnus sp.?*	Pin Oak	Hartford	Very large species crawling on bark of dead branches.
“ 24	Aphis on Maple, *Callipterus sp.?*	Norway Maple	Chestnut Hill	A few specimens on leaves. Sooty fungus abundant in honey dew.
	Pear Psylla, *Psylla pyricola* Först.	Pear	“	Sooty fungus and cast skins present.
Oct. 3	San José Scale, *Aspidiotus perniciosus* Comst.	Peach	Stamford	Badly infested twigs.
	Spruce Bud-Louse, *Chermaphis abietis* L.?	Norway Spruce	“	Empty galls on new growth.
“ 6	San José Scale, *Aspidiotus perniciosus* Comst.	Apple	Westerly, R. I.	Thoroughly infested.
	House Centipede, *Scutigera forceps* Raf.		Hartford	A myriapod found in cellar.
“ 8	Pear Psylla, *Psylla pyricola* Först.	Pear	South Windsor	Abundant on leaves and twigs.
	Oyster-shell Bark-Louse, *Mytilaspis pomorum* Bouché	“	“	A few specimens on twigs.
	Scurfy Bark-Louse, *Chionaspis furfurus* Fitch	Apple	“	“ “ “
“ 10	Chain-dotted Geometer, *Cingilia catenaria* Dru.		Bloomfield	Single adult specimen.
	Soldier Beetle, *Telephorus carolinus* Fabr.		“	Adult somewhat crushed.
	Assassin Bug, ———		“	Too badly crushed for recognition.
	“ ———		“	

INSECTS AND OTHER ANIMALS RECEIVED FOR IDENTIFICATION—*Continued.*

DATE.		NAME.	HOST.	LOCALITY.	REMARKS.
Oct.	16	Northern Mole-Cricket, *Gryllotalpa borealis* Burm.		Bloomfield	First specimen in Station collection. Said to be rare in Connecticut.
"	19	Pine Scale, *Chionaspis pinifoliæ* Fitch	White Pine	Hartford	Leaves covered with scales.
"	21	San José Scale, *Aspidiotus perniciosus* Comst.	Apple	Greenwich	Badly infested.
		White-Fly, *Aleyrodes vaporariorum* Westw.	*Eupatorium*	Terryville	Under surface of leaves covered with adults and larvæ.
Nov.	17	Hemipterous eggs ———?	Apple	Warehouse Point	Eggs in clusters on twigs.
"	28	San José Scale, *Aspidiotus perniciosus* Comst.	"	Meriden	Young still crawling, though the weather had been cold for several days.
Dec.	1	" " "	Japan Plum	Wethersfield	Badly infested.
"	9	" " "	Currant	New Haven	A number of specimens on short twig. A few had just set.
		Cherry Scale, *Aspidiotus forbesi* Johns	Cherry	"	One mature female present.
		——— *Aspidiotus ulmi* Johns?	Elm	"	Many dead scales on inner bark under edges of thick bark.
		White Scale, *Chionaspis americana* Johns	"	"	Only the eggs were present.
"	16	San José Scale, *Aspidiotus perniciosus* Comst.	Apple	Plantsville	Sent for examination as to mortality.
"	19	" " "	Pear	New Haven	A few scattered specimens on small twigs.
		Oyster-shell Bark-Louse, *Mytilaspis pomorum* Bouché.	Butternut	Yantic	Bark thoroughly covered with old shells.
"	24	——— Scale, *Eulecanium cerasifex* Fitch	Japan Plum	Berlin	
"	28	San José Scale, *Aspidiotus perniciosus* Comst.	Peach	"	Branch moderately infested.
		" " "	Cherry, Pear	Plantsville	A few dead scales around buds. Had been treated.
"	30	" " "	Apple, Pear	Hartford	A few scales around buds: some alive and some dead.
		Mite, probably *Bryobia pratensis* Garman	Apple	"	Red spherical eggs clustered around the buds.
		Ground Snake, *Carphophiops amœnus* Say		Lenox, Mass.	Immature specimen between four and five inches in length.

SENDING INSECTS BY MAIL.

Recently, the statement has been made in the public press that, on account of the great liability of distributing dangerous pests, all insects would be excluded from the mails. This statement was made once, at least, in connection with an account of the cotton boll worm, which is causing such losses to the cotton growing industry of the southern states.

The following article by Dr. L. O. Howard of Washington, D. C., was published in *Entomological News* for January, 1904, and is self-explanatory. It is here reproduced by permission of the editor, Dr. Henry Skinner.

"While there has been a very general exchange of cabinet specimens of insects by means of the United States mails, and while people have sent to the state entomologists and to the government entomologists living specimens with supplies of food, Section 494 of the Postal Laws and Regulations (page 226) specifically excludes insects from the mails. The enforcement of this regulation by a southern postmaster recently caused Mr. Wilmon Newell, State Entomologist of Georgia, to urge me to inform him accurately as to the attitude of the Post Office Department on this subject. I therefore prepared for the signature of the Honorable, the Secretary of Agriculture, a letter addressed to the Postmaster General asking for a modification of this section on the ground that its enforcement would hamper the work of the Department of Agriculture and would cause serious inconvenience to entomologists all through the country. The Postmaster General replied promptly and wisely, and courteously agreed to the suggestion of Secretary Wilson and urged that a representative of the Department of Agriculture be appointed to discuss any proposed amendment with the Superintendent of the Railway Mail Service. I was designated to act for the Secretary of Agriculture, and after consultation with Mr. Alexander Grant, Assistant General Superintendent of the Railway Mail Service, the following order was prepared and was issued by the Postmaster General:

OFFICE OF THE POSTMASTER GENERAL,
Washington, D. C., Feb. 16, 1903.

Order No. 1269a.

Modify the Postal Laws and Regulations, edition of 1902, as follows: Section 494, paragraph 1, line 3: Omit the word "insects."

Section 496: Omit paragraph 7 and insert in lieu thereof the following:

7. Queen bees and their attendant bees, the "Australian lady bird," insects (live or dried), and dried reptiles may be sent in the mails when so put up as to render it practically impossible that the package shall be broken in transit, the persons of those handling the mails injured, or the mail bags or their contents soiled. (See paragraph 1 of this Section.)

H. C. PAYNE,
Postmaster General.

Knowing that this order will be of wide interest to entomologists, I trust that this communication will be published in *Entomological News.*"

This ruling of the postal authorities makes it possible to send insects by mail when properly packed, and I take this opportunity to say a word to correspondents on this point. Specimens should never be placed, loose, in an envelope. Even if they do not escape, or soil the contents of the mail bag, they are usually crushed beyond all recognition when received. Insects should be enclosed in a strong pasteboard, tin, or wooden box so that they cannot be crushed. Where possible, it is well to include a portion of the food plant, but it is never necessary to punch holes in the box to admit air. Insects can usually obtain plenty of air, even in a closed box.

TWO COMMON SCALE-INSECTS OF THE ORCHARD.*

The Scurfy Bark-Louse *Chionaspis furfurus* Fitch.

The Oyster-Shell Bark-Louse *Mytilaspis pomorum* Bouché.

Long before Connecticut orchards were attacked by the San José or pernicious scale-insect, the scurfy bark-louse and the oyster-shell bark-louse were present as parasites upon the trees and caused considerable damage each year. These orchard enemies still injure trees, though their work has been somewhat overshadowed by the damage of the San José scale during the last few years. The two kinds of scale-insects described in this publication are frequently received at the Station and the correspondent usually asks if it is the San José scale. This bulletin has been prepared for the purpose of distributing information about these two common species and the remedies for them, as well as to point out wherein they differ in appearance from the San José scale. The San José scale-insect has three or four broods each year, is circular in outline, and is shown in figure 27. The oyster-shell and scurfy bark-lice are much larger, elongated or pear-shaped, and single brooded. See figures 28 and 30.

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* This paper was published as Bulletin 143 in May, 1903, in an edition of 12,000 copies. It is here reproduced with slight changes.

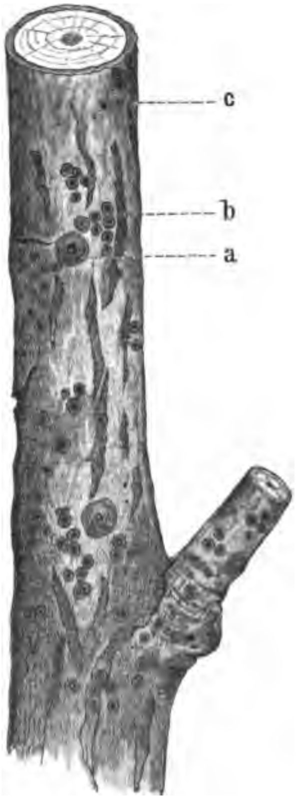

FIG. 27.—San José scale on peach twig: a. mature female: b. young females: c. immature males. About twice natural size.

The life histories of the species forming the subject of this bulletin are so nearly alike that the same remedial treatment answers for both.

The terms "scale" and 'bark-louse" are both applied to insects of this group (*Coccidæ*) and may be considered as synonymous with the compound word "scale-insect."

The Scurfy Bark-Louse.

The scurfy bark-louse is a native of North America, and was formerly called "Harris' Bark-Louse." It is now found throughout the United States, and, according to Howard, is being succeeded by the oyster-shell bark-louse.*

The female scale is about 3 mm. (⅛ inch) in length, broadly pear-shaped, with the cast larval skin at the smaller end which usually points upward. The color is light grey or white. The male scale is much smaller than the female, pure white, with three parallel ridges along the back, and parallel sides. Males and females usually occur on separate twigs. Both sexes are shown in figure 28.

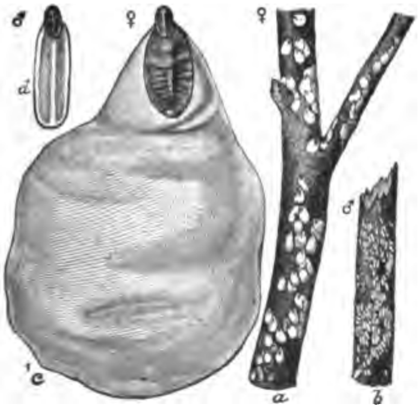

Fig. 28.—Scurfy bark-louse: a. c. females: b. d. males. a. b. natural size: c. d. much enlarged. (After Howard, Division of Entomology, U. S. Department of Agriculture, Year-book for 1894.)

There is only one generation each year in Connecticut. The eggs hatch during the latter part of May. Our records show that on May 19th, 1902, material was brought to the Station from North Guilford, and that some of the eggs had hatched.

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* Year-book, 1894, U. S. Department of Agriculture, p. 259, Washington, D. C.

The writer has made observations on this point for several years and usually the eggs hatch here between May 20th and June 1st.

The newly-hatched insect (see figure 29, c) crawls about for a short time, then becomes fixed, forms a shell and sucks the sap from the tree. The female becomes mature during September, and later dies and shrivels up, leaving the old shell filled with oval, purple eggs. Usually between thirty and fifty eggs are produced by each female. In Connecticut the writer found the eggs as early as October 1st in 1900, while they had not been formed on October 9th, 1901. Usually they are formed during the first week in October. Howard states that in the vicinity of Washington the eggs are formed October 15th and hatch uniformly about the middle of May.* There is probably more than one brood in the Southern States.

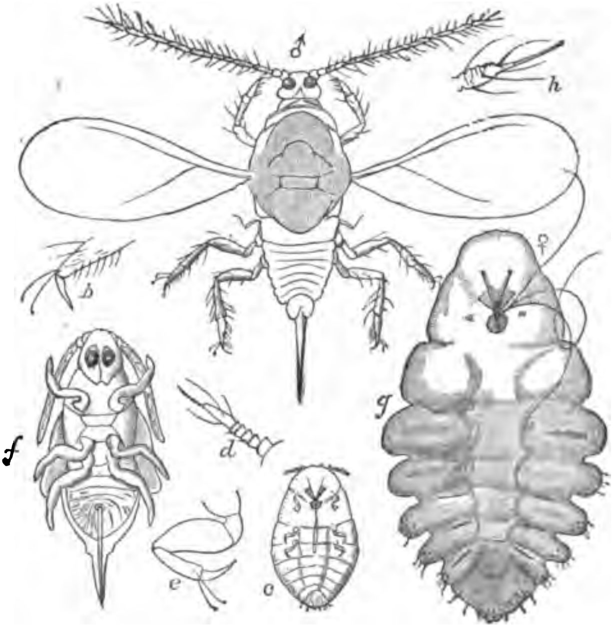

FIG. 29.—Scurfy bark-louse: adult male above: b. foot: h. tip of antenna: c. larva: d. antenna of larva: e. leg of larva: f. pupa: g. adult female with armor removed. All greatly enlarged. (After Howard, Division of Entomology, U. S. Department of Agriculture, Year-book for 1894.)

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* *Loc. cit.*

The chief injury caused by this species occurs to young pear and apple trees either in nursery rows or in newly-set orchards. Sometimes the bark of the trunk and branches is entirely covered by the grey shells, thus giving the tree the appearance of having been whitewashed. Such trees make little growth and are frequently killed outright. Seldom do we find the insect abundant on large trees. Currant bushes are often infested and mountain ash and hawthorn are frequently attacked by the scurfy bark-louse. The appearance of an infested currant twig is shown on Plate I.

THE OYSTER-SHELL BARK-LOUSE.

This insect is well known and occurs all over the world. Europe is thought to be its original home, but it has been known to be present in the United States for over one hundred

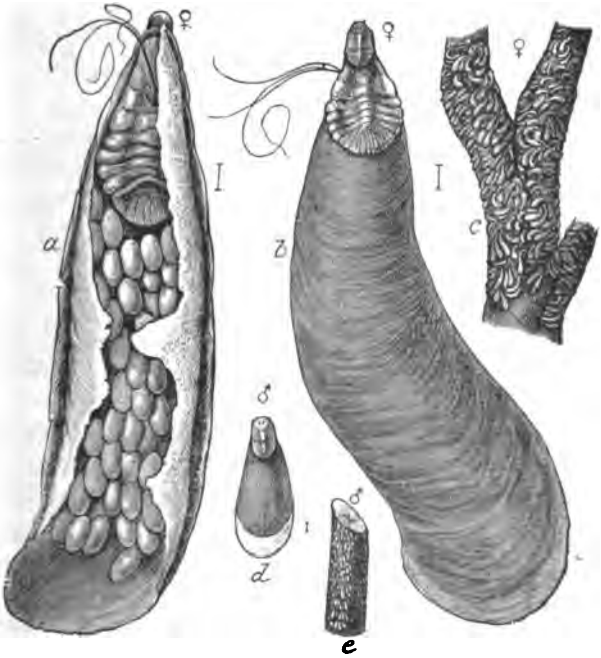

FIG. 30.—Oyster-shell bark-louse: a. female scale from below showing eggs: b. dorsal view of same: d. male scale—all enlarged: c. females; e. males—natural size on twigs. (After Howard, Division of Entomology, U. S. Department of Agriculture, Year-book for 1894.)

years. It is more common at the North, where it is single-brooded, than in the South, where two generations occur each year.

The armor of the female (shown in figure 30) is about 3 mm. (⅛ inch) long, narrow and usually somewhat curved, and nearly the same color as the bark upon which it is found. The cast larval skin may be seen at the pointed end. Generally it is darker in color than the scurfy bark-louse, as well as narrower. The armor of the male is much smaller and less curved than that of the female. The male scales are seldom seen upon fruit trees. The adult male (shown in figure 31) is provided with a pair of wings, legs, antennæ and eyes, and resembles the male of the scurfy bark-louse.

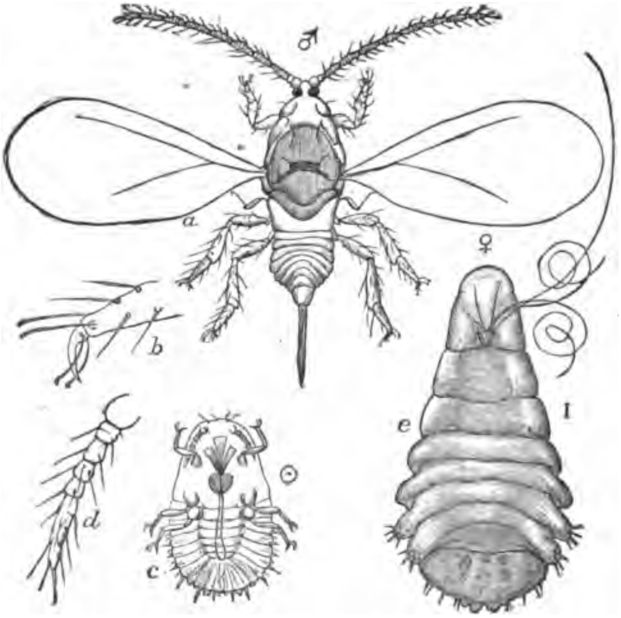

FIG. 31.—Oyster-shell bark-louse: a. adult male: b. foot: c. larva; d. antenna of larva: e. adult female with armor removed. All greatly enlarged. (After Howard, Division of Entomology, U. S. Department of Agriculture, Year-book for 1894.)

The oyster-shell bark-louse, like the scurfy bark-louse, passes the winter in the egg stage and the small, oval, white or pale yellow eggs hatch about the first of June or a few days later than the eggs of the scurfy bark-louse. The young were crawling on twigs received at the Station June 9th, 1902. As many as one hundred eggs are sometimes laid by a single female.

No observations have been made by the writer regarding the time when the eggs are laid in the fall, but eggs were formed in specimens collected in December. According to Smith the eggs are formed late in August and during September.*

The oyster-shell bark-louse is found on nearly every old apple tree in Connecticut, and may occur on the small twigs and on the large branches and trunk in the crevices of the rough bark. It weakens trees unquestionably, but the writer has never seen fruit trees killed by the oyster-shell bark-louse in Connecticut. Many seedlings and sprouts of native trees in fields and woods are killed each year by it. Ash, poplar, willow, birch, butternut, black-walnut and maple are the trees most commonly injured, and are frequently infested to such an extent that no portion of the bark can be seen.

In nurseries and ornamental plantations lilac, Kilmarnock willow and some species of *Elæagnus* are often seriously infested.

The appearance of twigs and branches infested by the oyster-shell bark-louse is shown on Plate II.

REMEDIES.

The eggs of both the scurfy and the oyster-shell bark-lice are hard to kill, so that winter applications are not effective in fighting the species. Some writers advise a winter application of whitewash to destroy them: this frequently causes the shells to fall from the bark and the eggs are scattered, and perhaps to such an extent that the young are not able to reach the tree. But many eggs remain on the tree and are not injured by the whitewash. Frequently these eggs withstand applications of kerosene and crude oil. The most vulnerable point in the life history of both species is just after the eggs hatch, while the young are crawling and before they have become protected by the formation of their shells or armor. In Connecticut this period occurs during the first half of June, and the newly-hatched insects may be destroyed readily by spraying with any of the common contact insecticides. Common soap and water (1 lb. dissolved in 8 gallons) is as convenient as any application and is cheap and effective. Any laundry soap will answer. It should be cut in thin slices, dissolved in boiling water and diluted to make the proper proportions. Whale-oil soap in the same proportions can also be used. Kerosene emulsion is recommended, and a mechanical mixture of kerosene and water, containing from 10 to 15 per cent. of kerosene, applied with a "Kerowater" pump, is also a cheap and satisfactory remedy.

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* Bull. 140, New Jersey Exp. Station, p. 5.

SUMMARY.

1. The scurfy bark-louse and oyster-shell bark-louse have commonly injured fruit trees for many years in Connecticut by sucking out the sap and are often mistaken for the San José scale-insect, which, on account of a different life-history, must receive different treatment.

2. The scurfy bark-louse is a native of North America and is well distributed over the United States. The female is light grey and pear-shaped, while the male is much smaller, white with parallel sides. There is one brood each year at the North. It winters in the egg stage and the eggs hatch during the latter part of May. Eggs for the next brood are laid the first week in October. Small apple and pear trees and currant bushes are the most seriously infested and are sometimes killed.

3. The oyster-shell bark-louse is found all over the world, and was probably introduced into this country from Europe more than a hundred years ago. It is darker in color and narrower than the scurfy bark-louse; the life history is very similar, but the eggs are a few days later in hatching, and are formed earlier in the fall. There is one brood each year. It infests apple, but is common on ash, poplar, willow, butternut and lilac, often killing them.

4. Spraying the trees during the first two weeks in June, or while the young are crawling, with soap and water (1 lb. in 8 gals.) or with kerosene emulsion will readily destroy the newly-hatched larvæ.

FIGHTING THE SAN JOSÉ SCALE-INSECT IN 1903.*

By W. E. Britton and B. H. Walden.

During the season of 1903, spraying experiments directed against this most destructive insect were conducted at Yalesville, Southington, Westville and New Haven.

One of the most extensive spraying operations ever conducted in the state was carried out at the orchard of Barnes Brothers at Yalesville. A short account of the work done in this orchard in 1902 was given in the Second Report of the State Entomologist, page 120. During March and April of the present year, about 11,000 trees were sprayed by the owners, and a brief account has been published in the Report of the Connecticut Pomological Society for 1902, page 217.

Barnes Brothers cordially coöperated with the Station in experimenting with various mixtures, and especially in developing practical methods of preparing and applying them, in order to make the work of greater value to the orchardists of the State.

At Southington, the writers sprayed over 200 peach and 50 apple trees with various substances during the latter part of March. Some of the mixtures were not effective in killing the scales and 100 of the peach trees were again sprayed August 10th, to prevent the further increase of the insects.

Various spraying mixtures were tested on about 150 pear trees in Westville on April 1st.

Late in the winter some fruit trees upon the Station grounds were found to be moderately infested, and several preparations were here applied to 35 trees of various kinds during March and April.

The results of the experiments have been tabulated and these, together with a somewhat detailed account of the conditions under which they were made, as well as a few practical directions for doing the work, appear in the following pages.

Spraying Dormant Trees.

Most of the experimental work consisted in spraying the dormant trees in late winter or early spring with various insec-

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* This was published as Bulletin 144, in October, in an edition of 12,000 copies. It is here reproduced with appropriate emendations.

INSECTS AND OTHER ANIMALS RECEIVED FOR IDENTIFICATION—*Continued.*

DATE.	NAME.	HOST.	LOCALITY.	REMARKS.
June 25	Cherry Aphis, *Myzus cerasi* Fabr.	Cherry	Guilford	Leaves curled. Black aphis.
	Currant Fruit Worm	Currant	East Norwalk	Infesting berries of Fay's Prolific variety.
" 27	Green Apple Aphis, *Aphis pomi* DeG.?	Apple	Glastonbury	Too badly crushed for specific identification.
	Currant Aphis, *Myzus ribis* L.?	Currant	"	
	Cherry Aphis, *Myzus cerasi* Fabr.?	Cherry	"	
	Green Apple Aphis, *Aphis pomi* DeG.?	Apple	Cannon Station	
" 30	" " "	"	Windsor Locks	Young twigs covered with green lice.
	——— *Hamamelistes spinosus* Shimer	White Birch	New Haven	On birch leaves, killing them.
July 1	Rudbeckia Aphis, *Nectarophora rudbeckiæ* Fitch	*Rudbeckia* Golden Glow	"	Red aphis on stalks.
	Strawberry Leaf-Roller, *Ancylis comptana* Frœl.	Dewberry	Highwood	Quite abundant in field of Lucretia dewberries.
	Fruit Bark Beetle, *Scolytus rugulosus* Ratz.	Japan Plum	Hamden	Seriously injuring trees.
" 3	Currant Fruit Worm, ———	Currant	Norwalk	Infesting berries.
" 7	Aphis, *Nectorophora sp.?*	Potato	Fairfield	Very abundant on leaves and stems.
	Pear Psylla, *Psylla pyricola* Först.	Pear	Hartford	Causing leaves to fall. Honey dew and insects abundant.
" 9	Unicorn Caterpillar, *Schizura unicornis* S. & A.	Apple	Shelton	Partially grown larva devouring leaves.
	Maple Aphis, *Chaitophorus sp.?*	Norway Maple	East Norwalk	Infesting leaves. Honey dew abundant.
" 10	Aphis ———	Hop	Westville	Black lice on leaves.
	Lady Beetle, ———?	"	"	Larvæ feeding upon the plant lice.
	Glow Worm, *Phengodes sp.?*		Waterbury	Appears to be a larva. 1 inch long. Found in grass under maple trees.
" 14	Twice-stabbed Lady Beetle, *Chilocorus bivulnerus* Muls.	Apple	Bloomfield	Pupæ and larval skins present.
	Pear Psylla, *Psylla pyricola* Först.	Pear	Portland	Fruit and leaves badly infested.
" 15	Work of Flea-Beetle, ———?	Potato	Bristol	Leaves perforated.
" 16	Pear Psylla, *Psylla pyricola* Först.	Pear	Seymour	Leaves badly infested and falling.
	Apricot Scale, *Eulecanium armeniacum* Craw.	Japan Plum	"	Twig covered by old shells. Young crawling.

INSECTS AND OTHER ANIMALS RECEIVED FOR IDENTIFICATION—*Continued.*

DATE.		NAME.	HOST.	LOCALITY.	REMARKS.
July	17	Green Apple Aphis, *Aphis pomi* DeG.	Apple	West Haven	Specimen crushed.
"	18	Maple Borer, *Plagionotus speciosus* Say.	Maple	New Haven	Adult and larvæ of different sizes.
		——— *Alaria florida* Gn.		"	Found in building.
		Pear Psylla, *Psylla pyricola* Först.	Pear	Hamden	On twigs of new growth causing leaves to curl.
"	20	Senator Moth, *Anisota senatoria* S. & A.		New Haven	Adult found in raspberry patch.
"	23	Apple-Tree Tent-Caterpillar, *Clisiocampa americana* Harris	Peach	Lyme	Egg-mass on twig.
"	29	Long-horned Beetle, *Romaleum atromarium* Dru.		New Haven	Adult crawling under oak tree.
"	31	Green Apple Aphis, *Aphis pomi* DeG.	Apple	Cheshire	On under surface of leaves.
		Lesser Prionus, *Orthosoma brunneum* Först.		New Haven	Crawling in dwelling house.
		——— *Chrysochus auratus* Fabr.		West Haven	Single adult specimen.
		Mexican Jumping Seeds, ———?	*Euphorbia*	Mexico	Larva inside of each locule.
Aug.	1	Lesser Prionus, *Orthosoma brunneum* Först.		New Haven	
"	4	Pear Psylla, *Psylla pyricola* Först.	Pear	West Granby	On leaves and twigs.
"	6	" " "	"	Woodbury	" "
"	8	Celery Butterfly, *Papilio polyxenes* (*asterias*) Fabr.		New Haven	Male and female adults.
"	12	Chain-dotted Geometer, *Cingilia catenaria* Dru.	Sweet Fern	Terryville	Yellow and black larvæ feeding on various low growing shrubs.
"	14	Peach Borer, *Sanninoidea exitiosa* Say.	Peach	Hartford	
		Robber Fly, *Erax bastardi* Macq.		"	
"	17	Saddle-back Caterpillar, *Sibine stimulea* Clem.	Corn	Hamden	
"	22	Assassin Bug, *Acholla multispinosa* DeG.	Apple	Warehouse Point	Found crawling on trees.
"	24	San José Scale, *Aspidiotus perniciosus* Comst.	Plum	Rockville	Badly infested.
"	25	Saddle-back Caterpillar *Sibine stimulea* Clem.		New Haven	
"	28	Dog-day Harvest-fly, *Cicada tibicen* Linn.		Windsor	Found in cellar of dwelling.
"	29	Fruit Bark-Beetle, *Scolytus rugulosus* Ratz.	Plum	Cheshire	
		Hymenopterous insects ———		"	Evidently parasites upon preceding.
"	31	———	Hickory	New Haven	Larva found in twigs where adult *Scolytus quadrispinosus* occurred.

INSECTS AND OTHER ANIMALS RECEIVED FOR IDENTIFICATION—*Continued.*

DATE.		NAME.	HOST.	LOCALITY.	REMARKS.
Sept.	5	Pine Aphis, *Lachnus strobi* Fitch	Pine	Springdale	Twigs and leaves covered with sooty fungus growing in the honey dew.
		White Scale, *Chionaspis americana* Johns	Elm	Hartford	Supposed to have killed the branches.
"	8	Scurfy Bark-Louse, *Chionaspis furfurus* Fitch	Apple	Higganum	Both sexes present.
		Green Apple Aphis, *Aphis pomi* DeG.	"	"	Cast skins and parasitized aphids on under surface of leaf.
		San José Scale, *Aspidiotus perniciosus* Comst.	Japan Plum	"	A few specimens on twigs.
		Work of Fruit Bark Beetle, *Scolytus rugulosus* Ratz.	"	"	Small holes in bark of twigs.
		Checkered Tussock Caterpillar, *Halisidota tessellaris* S. & A.		New Haven	Larva crawling about buildings.
"	10	Spruce Bud-Louse, *Chermaphis abietis* L.?	Spruce	"	Empty galls made in spring.
"	14	San José Scale, *Aspidiotus perniciosus* Comst.	Currant, Apple	Portland	Twigs well infested. Young crawling.
		Scurfy Bark-Louse, *Chionaspis furfurus* Fitch	Apple	"	Mostly males present.
		Locust Borer, *Cyllene robiniæ* Först.	Locust	New Haven	Male and female collected on locust tree.
		Brown Beetle, *Xyleborus celsus* Eich.	Hickory	"	Boring in wood of trunk.
"	21	Plant Louse, *Lachnus sp.?*	Pin Oak	Hartford	Very large species crawling on bark of dead branches.
"	24	Aphis on Maple, *Callipterus sp.?*	Norway Maple	Chestnut Hill	A few specimens on leaves. Sooty fungus abundant in honey dew.
		Pear Psylla, *Psylla pyricola* Först.	Pear	"	Sooty fungus and cast skins present.
Oct.	3	San José Scale, *Aspidiotus perniciosus* Comst.	Peach	Stamford	Badly infested twigs.
		Spruce Bud-Louse, *Chermaphis abietis* L.?	Norway Spruce	"	Empty galls on new growth.
"	6	San José Scale, *Aspidiotus perniciosus* Comst.	Apple	Westerly, R. I.	Thoroughly infested.
		House Centipede, *Scutigera forceps* Raf.		Hartford	A myriapod found in cellar.
"	8	Pear Psylla, *Psylla pyricola* Först.	Pear	South Windsor	Abundant on leaves and twigs.
		Oyster-shell Bark-Louse, *Mytilaspis pomorum* Bouché	"	"	A few specimens on twigs.
		Scurfy Bark-Louse, *Chionaspis furfurus* Fitch	Apple	"	" " "
"	10	Chain-dotted Geometer, *Cingilia catenaria* Dru.		Bloomfield	Single adult specimen.
		Soldier Beetle, *Telephorus carolinus* Fabr.		"	Adult somewhat crushed.
		Assassin Bug, ——		"	Too badly crushed for recognition.
		" ——		"	

INSECTS AND OTHER ANIMALS RECEIVED FOR IDENTIFICATION—*Continued.*

DATE.	NAME.	HOST.	LOCALITY.	REMARKS.
Oct. 16	Northern Mole-Cricket, *Gryllotalpa borealis* Burm.		Bloomfield	First specimen in Station collection. Said to be rare in Connecticut.
" 19	Pine Scale, *Chionaspis pinifoliæ* Fitch	White Pine	Hartford	Leaves covered with scales.
" 21	San José Scale, *Aspidiotus perniciosus* Comst.	Apple	Greenwich	Badly infested.
	White-Fly, *Aleyrodes vaporariorum* Westw.	*Eupatorium*	Terryville	Under surface of leaves covered with adults and larvæ.
Nov. 17	Hemipterous eggs ——?	Apple	Warehouse Point	Eggs in clusters on twigs.
" 28	San José Scale, *Aspidiotus perniciosus* Comst.	"	Meriden	Young still crawling, though the weather had been cold for several days.
Dec. 1	" " "	Japan Plum	Wethersfield	Badly infested.
" 9	" " "	Currant	New Haven	A number of specimens on short twig. A few had just set.
	Cherry Scale, *Aspidiotus forbesi* Johns	Cherry	"	One mature female present.
	—— *Aspidiotus ulmi* Johns?	Elm	"	Many dead scales on inner bark under edges of thick bark.
	White Scale, *Chionaspis americana* Johns	"	"	Only the eggs were present.
" 16	San José Scale, *Aspidiotus perniciosus* Comst.	Apple	Plantsville	Sent for examination as to mortality.
" 19	" " "	Pear	New Haven	A few scattered specimens on small twigs.
	Oyster-shell Bark-Louse, *Mytilaspis pomorum* Bouché.	Butternut	Yantic	Bark thoroughly covered with old shells.
" 24	—— Scale, *Eulecanium cerasifex* Fitch	Japan Plum	Berlin	
" 28	San José Scale, *Aspidiotus perniciosus* Comst.	Peach	"	Branch moderately infested.
	" " "	Cherry, Pear	Plantsville	A few dead scales around buds. Had been treated.
" 30	" " "	Apple, Pear	Hartford	A few scales around buds: some alive and some dead.
	Mite, probably *Bryobia pratensis* Garman	Apple	"	Red spherical eggs clustered around the buds.
	Ground Snake, *Carphophiops amœnus* Say		Lenox, Mass.	Immature specimen between four and five inches in length.

The average cost per tree could have been lessened by using two lines of hose on each pump, as one man can easily pump for two lines of hose.

Most of the orchard was sprayed with a mixture containing 20 pounds lime, 14 pounds sulphur, 10 pounds salt and 40 gallons water. The lime was slaked carefully, the sulphur and salt added and the whole boiled slowly for about one and one-half hours.

A portion of the orchard was sprayed with this mixture in November and December, 1902, but as an examination in March showed that there were still many living insects, these trees were again sprayed during the spring.

About thirty days, with the entire force at work, were required to spray the 11,000 trees.

Results at Yalesville.

The buds were well developed and were opening before the spraying could be finished. Some of these were injured. Otherwise there was no injury to the trees.

The percentages of insects living on June 17th, given in Tables I and II, probably do not represent accurately the number that brought forth young this season, for some of these were not healthy when examined and doubtless would not be able to reproduce. An examination of the orchard on September 11th, nearly three months after the breeding season began, showed that the results had been generally satisfactory, as it was extremely difficult to find living scales on the sprayed trees. None were found on the trees which were sprayed twice (December and April).

Very little difference could be seen in the effects of mixtures containing different quantities of sulphur.

A portion of the orchard was sprayed very late just before the leaves appeared, and some trees were in blossom. The open buds were destroyed, but the mixture remained for a longer time on these trees, doubtless on account of being protected by the foliage. Six months after spraying, the trunks and larger branches were still white.

One small orchard owned by Barnes Brothers was not sprayed at all, and Mr. Barnes states that this orchard produced peaches that were badly infested with the "scab" fungus. Fruit of the same variety from a near-by sprayed orchard was almost entirely free from "scab," indicating strongly that the lime, sulphur and salt mixture, as had been supposed, is of considerable value as a fungicide.

Westville Experiments.

The trees that were here treated were all pear, and set in nearly a square block having fifteen rows with ten to eleven trees in each row. Nearly all of the trees were badly infested and some had been killed by the scale and were removed, so that only 144 trees were actually sprayed in this experiment. The scales had completely encrusted many trees and greatly impaired their vitality: otherwise the conditions were favorable for experimental spraying work.

The spraying was done on April 1st, a bright sunny day, with a breeze from the northwest. The orchard was divided into sections for treatment with the different insecticides. Beginning on the west side, the first row of nine trees was sprayed with Derrick crude oil and water (25 per cent. oil) applied with a "Success" kerosene bucket sprayer. The second, third, fourth and fifth rows were sprayed with whitewash, using 20 pounds of lime to 40 gallons of water. The sixth row was sprayed with sulphide of potash and lime in water (5 pounds sulphide of potash, 5 pounds of lime, 10 gallons of water). The seventh and eighth rows were sprayed with strong Bordeaux mixture composed of 5 pounds of copper sulphate, 5 pounds of lime and 20 gallons of water.

The ninth, tenth, eleventh and twelfth rows were sprayed with the lime and sulphur mixture (no salt), containing 20 pounds of lime, 14 pounds of sulphur and 40 gallons of water, the lime and sulphur being boiled together in a concentrated solution for one hour.

The thirteenth, fourteenth and fifteenth rows were sprayed with the regular lime, sulphur and salt mixture, made by boiling together for one hour 20 pounds of lime, 14 pounds of sulphur, 10 pounds of salt and enough water added to make 40 gallons.

The lime, sulphur and salt, and the lime and sulphur mixtures were boiled for about one hour in a large iron kettle devised for cooking stock feed.

TABLE III.—WESTVILLE EXPERIMENTS. DORMANT TREES SPRAYED APRIL 1, 1903.

Experiment Number.	Kind of trees.	Number of trees treated.	Condition of trees before treatment.	Materials applied.	Out of 100 Scales on Twigs— Winter-killed.	Killed by treatment.	Alive after treatment.	Percentage efficiency of treatment.	Effect of treatment on trees.
82	Pear.		Badly infested.	20 p. c. Crude Oil in water.	24.	76.	0	100	No apparent injury.
83	"		"	"	24 6	75.4	0	100	
84	"		"	"	21.8	78.2	0	100	"
85	"		"	"	17.	83.	0	100	"
86	"		"	"	38.	62.	0	100	
87	"		"	"	36.5	63.5	0	100	"
88	"	9	"	"	37.	63.	0	100	"
Average					**28.4**	**71.6**	**0**	**100**	
103	Pear.		Badly infested.	Lime and Sulphide of Potash	23.	69.	8.	89	"
106	"		"	10 lbs. sulphide of potash,	43.6	54.9	1.5	97	"
107	"	11	"	10 lbs. lime, 20 galls. water.	17.	72.	11.	86	"
Average					**27.5**	**65.3**	**6.8**	**91**	
104	Pear.		Badly infested.	Strong Bordeaux Mixture.	25.9	62.1	12.	83	"
105	"		"	5 lbs. copper sulphate.	24.7	66.4	8.9	88	"
108	"		"	5 lbs. lime.	24.	56.	20.	74	"
109	"		"	20 galls. water.	30.9	65.1	4.	93	"
110	"		"	"	27.	62.	11.	85	"
111	"	20	"	"	12.3	77.7	10.	88	"
Average					**24.1**	**64.9**	**10.9**	**85**	

TABLE IV.—WESTVILLE EXPERIMENTS. DORMANT TREES SPRAYED APRIL 1, 1903.

Experiment Number.	Kind of trees.	Number of trees treated.	Condition of trees before treatment.	Materials applied.	Out of 100 Scales on Twigs—			Percentage efficiency of treatment.	Effect of treatment on trees.
					Winter-killed.	Killed by treatment.	Alive after treatment.		
89	Pear.		Badly infested.	Whitewash. 20 lbs. lime. 40 galls. water.	36.8	39.2	24.	62	No apparent injury.
90	"		"		35.5	50.5	14.	78	
91	"		"		26.4	60.6	13.	82	"
92	"		"	"	24.	51.	25.	67	"
93	"		"	"	19.4	66.6	14.	82	"
94	"		"	"	28.	52.	20.	72	"
95	"		"	"	32.	54.	14.	80	"
96	"		"	"	34.8	36.2	29.	55	"
97	"		"	"	18.9	65.1	16.	80	"
98	"		"	"	24.	68.	8.	90	"
99	"		"	"	29.	25.	46.	35	"
100	"		"	"	24.	54.	22.	71	"
101	"	37	"	"	32.8	57.2	10.	85	"
Average	....	....	....	....	**28.1**	**52.2**	**19.**	**72**	

TABLE V.—WESTVILLE EXPERIMENTS. DORMANT TREES SPRAYED APRIL 1, 1903.

Experiment Number.	Kind of trees.	Number of trees treated.	Condition of trees before treatment.	Materials applied.	Out of 100 Scales on Twigs—			Percentage efficiency of treatment.	Effect of treatment on trees.
					Winter-killed.	Killed by treatment.	Alive after treatment.		
112	Pear.		Badly infested.	Lime and Sulphur.	25.	64.	11.	85	No apparent injury.
113	"		"	20 lbs. lime.	22.	66.	12.	84	"
114	"		"	14 lbs. sulphur.	37.	58.	5.	92	"
115	"		"	40 galls. water.	25.6	64.4	10.	86	"
116	"		"	"	26.5	60.5	13.	82	"
117	"		"	"	22.	75.	3.	96	"
118	"		"	"	32.5	45.5	22.	67	"
119	"		"	"	33.	63.	4.	94	"
120	"		"	"	24.	70.	6.	90	"
121	"		"	"	20.5	72.5	7.	91	"
122	"		"	"	25.	67.7	7.3	90	"
123	"	39	"	"	30.	68.1	1.9	97	"
Average	....	......	....	....	**26.7**	**64.5**	**8.5**	**88**	
124	Pear.		Badly infested.	Lime, Sulphur, Salt.	26.9	70.1	3.	95	No apparent injury.
125	"		"	20 lbs. lime.	23.9	72.1	4.	94	"
126	"		"	14 lbs. sulphur.	25.	67.4	7.6	89	"
127	"		"	10 lbs. salt.	33.	65.	2.	97	"
128	"		"	40 galls. water.	30.9	65.1	4.	94	"
129	"		"	"	14.	83.2	2.8	96	"
130	"		"	"	31.	58.	11.	84	"
131	"	28	"	"	21.5	76.5	2.5	97	"
Average	....	....	....	....	**25.7**	**69.8**	**4.8**	**93**	

With the exception of the oil, all the spraying was done with an "Eclipse" barrel pump mounted on a two-wheeled cart and fitted with two lines of hose, bamboo extensions and double Vermorel nozzles.

Results at Westville.

The first row of trees sprayed with 25 per cent. crude oil mixed with water apparently suffered no injury from the treatment and no living insects could be found on the twigs examined. In former experiments, however, trees have been injured by oils, and in other states, notably Ohio, orchards have been seriously damaged by their use. The pumps for mixing oil and water are not reliable, and for these reasons the oils must be used cautiously in Connecticut.

The whitewash alone was not a success, because it washed off quickly and did not kill the scales. If it could be made to remain upon the trees as a coating until after the breeding season begins, it might be of considerable value as a mechanical barrier to the emergence of the young insects. A considerable number (ranging from 8 to 46, with an average of 19, per cent.) of the female scales were not killed by the whitewash.

Similar, though somewhat more satisfactory results, were obtained from the use of the strong Bordeaux mixture. This remained on the trees for a much longer time than the whitewash. But the cost of this mixture together with the results obtained do not warrant its use as a spray to kill the San José scale-insect.

The lime, sulphur and salt mixture made by boiling gave fairly satisfactory results, though more living insects were found than where the oil was applied. The trees remained white for quite a long time, and some of the mixture could still be seen on the under sides of the branches when the trees were examined on September 14th.

What has been said of the results attending the application of the lime, sulphur and salt mixture is also true of the sulphide of potash and lime, prepared without boiling. This was effective in killing the scales and did not wash off badly. It is too expensive for common orchard spraying, but is a convenience when only small quantities of the mixture are required.

The lime and sulphur (no salt) remained on the trees better than any other preparation except the strong Bordeaux mixture, but a larger percentage of insects survived than was the case where salt was used.

The results of the Westville experiments cannot be called satisfactory. Owing to the badly infested condition of the trees, more scales survived the treatment than in the other experiments. It is evident that the lime, sulphur and salt mixture, which forms a hard coating over the branches, does not have the penetrating power of the oils, and therefore is less effective where the trees are covered with several layers of scale-insects.

In such cases it would seem best to give two treatments with the lime, sulphur and salt where feasible—one in the fall soon after the leaves drop and another in spring just before the leaves appear.

Spraying at Southington.

Most of the trees sprayed were in a small peach orchard containing 200 trees. Fifty good-sized apple trees near-by were also treated. The peach trees were all infested by the scale-insect, though most of them had not been greatly injured. It was possible to find scales on nearly every tree. The orchard was on level ground and the trees were not large, making it an ideal place to conduct spraying experiments.

A man and pair of horses were hired for carting the water and the spraying mixture, and a Kinney "Safe" steam engine was hired from the town to boil the lime, sulphur and salt mixture. By attaching two lines of hose to the boiler, the mixture was boiled in two barrels at once, each barrel containing enough materials to make two barrels of mixture when diluted ready for application. The capacity of the boiler was sufficient to do twice the amount of work, as the steam had to be nearly shut off in order to prevent a too violent agitation of the liquid. The engine with boiler is shown mounted on a wagon on Plate IV, a.

The spraying pump and barrel were mounted upon a wagon and two lines of hose used at the same time, as is shown on Plate V, a. The mixtures used were: Whitewash—20 pounds lime, 40 gallons water; lime, sulphur and salt—20 pounds lime, 14 pounds sulphur, 10 pounds salt, 40 gallons water; lime and sulphur—20 pounds lime, 14 pounds sulphur, 40 gallons water;

TABLE VI.—EXPERIMENTS AT SOUTHINGTON. DORMANT TREES SPRAYED MARCH 26–28, 1903.

Experiment Number.	Kind of trees.	Number of trees treated.	Condition of trees before treatment.	Materials applied.	Out of 100 Scales on Twigs— Winter-killed.	Killed by treatment.	Alive after treatment.	Percentage efficiency of treatment.	Effect of treatment on trees.
28	Peach.		Thoroughly infested	Whitewash.	12.	69.	19.	78	No injury.
29	"		but not seriously	20 lbs. lime.	15.5	59.5	25.	70	"
33	"		injured.	40 galls. water.	18.	60.	22.	73	"
34	"		"	"	12.	63.	25.	71	"
35	"		"	"	16.	64.	20.	76	"
38	"		"	"	24.4	56.6	19.	74	"
39	"		"	"	27.	25.	48.	34	"
40	"		"	"	23.3	66.7	10.	86	"
44	"		"	"	17.7	61.3	21.	74	"
45	"		"	"	18.	62.	19.	75	"
46	"		"	"	28.7	46.3	25.	65	"
48	"		"	"	25.4	53.6	21.	71	"
50	"		"	"	25.	59.	16.	78	"
51	"		"	"	24.7	34.3	41.	45	"
58	"		"	"	20 5	44.5	25.	56	"
59	"		"	"	39.	46.	15.	75	"
60	"		"	"	17.	67.	16.	80	"
61	"		"	"	22.	58.	20.	74	"
62	"	100	"	"	26.6	60.4	13.	82	"
Average	....	....	....	....	**21.7**	**55.5**	**22.**	**70**	

TABLE VII.—EXPERIMENTS AT SOUTHINGTON. DORMANT TREES SPRAYED MARCH 26–28, 1903.

Experiment Number.	Kind of trees.	Number of trees treated.	Condition of trees before treatment.	Materials applied.	Out of 100 Scales on Twigs—			Percentage efficiency of treatment.	Effect of treatment on trees.
					Winter-killed.	Killed by treatment.	Alive after treatment.		
30	Peach.		Thoroughly infested,	Lime and	13.7	81.3	5.	94	No injury.
31	"		but not greatly in-	Sulphide of Potash.	18.	81.1	0.9	99	"
64	"		jured.	10 lbs. sul. potash.	25.	71.6	3.4	95	"
65	"		"	10 lbs. lime.	27.	72.	1.	98	"
66	"	12	"	20 galls. water.	19.8	80.2	0	100	"
Average	......	......	......	......	**20.7**	**77.2**	**2.**	**97**	
32	Peach.		Thoroughly infested,	Lime and Sulphur.	25.	72.	3.	96	"
37	"		but not greatly in-	20 lbs. lime.	23.	73.4	3.6	95	"
41	"		jured.	14 lbs. sulphur.	24.	72.	4.	94	"
42	"		"	40 galls. water.	20.	79.4	0.6	99	"
43	"		"	"	25.	73.	2.	97	"
67	"		"	"	25.8	70.4	3.8	94	"
68	"	61	"	"	18.	80.	2.	97	"
Average	......	......	......	......	**22.9**	**74.3**	**2.7**	**96**	

TABLE VIII.—EXPERIMENTS AT SOUTHINGTON. DORMANT TREES SPRAYED MARCH 26–28, 1903.

Experiment Number.	Kind of trees.	Number of trees treated.	Condition of trees before treatment.	Materials applied.	Out of 100 Scales on Twigs—			Percentage efficiency of treatment.	Effect of treatment on trees.
					Winter-killed.	Killed by treatment.	Alive after treatment.		
54	Peach.		Thoroughly infested, but not greatly injured.	Lime, Sulphur, Salt.	27.	71.	2.	97	No injury.
55	"				21.	77.	2.	97	"
57	"			20 lbs. lime.	31.	67.	2.	97	"
68	"		"	14 lbs. sulphur.	25.9	72.7	1.4	98	"
69	"		"	10 lbs. salt.	20.7	76.8	2.5	96	"
70	"		"	40 galls. water.	29.7	69.7	0.6	99	"
71	"	27	"	"	29.6	70.4	0	100	"
73	Apple.		"	"	40.9	57.1	2.	96	"
74	"		"	"	66.6	30.6	2.8	91	"
75	"		"	"	65.	31.	4.	88	"
76	"		"	"	50.	*	----	----	
77	"		"	"	42.6	55.4	2.	96	"
78	"		"	"	20.	75.2	4.8	94	"
79	"		"	"	57.6	39.7	2.7	93	"
80	"	50	"	"	66.	30.7	3.7	90	"
Average	....	....	....	....	39.5	58.8	2.3	95	

* Tree dead. Killed by scale-insect.

and lime and potassium sulphide—20 pounds lime, 20 pounds potassium sulphide, 40 gallons water. It was planned to use 25 per cent. of crude oil on a few trees, but the pump was not working properly on the days the spraying was done, and this had to be abandoned.

The trees were sprayed on March 26, 27 and 28, during fine weather, though a shower stopped the work before the apple trees were finished late in the afternoon of March 28.

The results are tabulated on pp. 245, 246 and 247.

Results at Southington.

The results obtained from the whitewash are disappointing. It did not remain long upon the trees and was not effective in destroying the scales. The trees were sprayed with kerosene emulsion in August (see page 252).

The lime, sulphur and salt, the lime and sulphur, and the lime and potassium sulphide mixtures were destructive to the scale and remained upon the trees for a long time. In fact, it was quite noticeable on the under sides of the branches when the orchard was visited on September 9th, and living scale-insects were very scarce on the trees in spite of the fact that badly infested trees were not far distant.

New Haven Experiments.

It has been stated on page 233 that the fruit trees on the Station-grounds were found to be infested. The discovery was made late in the season, but not too late to spray the trees before the leaves appeared. None of the fruit trees were badly infested though nearly all were infested to a slight degree.

Most of these trees (27) were sprayed with the lime, sulphur and salt mixture, 6 with whitewash and 2 with the Oregon wash (lime, sulphur and copper sulphate mixture). The lime, sulphur and salt mixture was boiled in barrels with steam from the heating system.

The following table gives the chief data:—

TABLE IX.—NEW HAVEN EXPERIMENTS. DORMANT TREES SPRAYED MARCH AND APRIL, 1903.

Experiment Number.	Kind of trees.	Number of trees treated.	Condition of trees before treatment.	Materials applied.	Out of 100 Scales on Twigs—			Percentage efficiency of treatment.	Effect of treatment on trees.
					Winter-killed.	Killed by treatment.	Alive after treatment.		
132	Apple.	8	Slightly infested.	Lime, Sulphur, Salt.	10.	85.	5.	96	No injury.
				20 lbs. lime. 14 lbs. sulphur. 10 lbs. salt. 40 galls. water.					
	Pear.	11	"	"					"
	Plum.	2	"	"					"
	Peach.	4	"	"					"
	Cherry.	2	"	"					"
133	Willow.	1	Badly infested.	Lime, Sulphur and Copper Sulphate. 20 lbs. lime. 14 lbs. sulphur. 10 lbs. cop. sul. 40 galls. water.	32.	61.4	6.6	90	"
134	Apple.	1	Slightly infested.	"	25.	50.	25.	50	"
Average	....	....	....	....	28.5	55.7	15.8	70	
	Pear.	6	Slightly infested.	Whitewash. 20 lbs. lime. 40 galls. water.	....	....	....	....	"
		35							

Results at New Haven.

Trees sprayed with the whitewash were so slightly infested that it was difficult to find specimens upon the twigs. They appeared very white when first sprayed, but the coating soon washed off and disappeared long before the lime, sulphur and salt.

The mixture containing copper sulphate in place of salt (Oregon wash) was dark-green or nearly black in color and could scarcely be seen on the bark. This also washed off early, though in one case it was fairly effective in destroying the scales.

The lime, sulphur and salt, however, was the most satisfactory of the three mixtures used at the Station.

TABLE X.—PERCENTAGE EFFICIENCY OF INSECTICIDES.

Materials.	Percentage Efficiency of Insecticides at				Average for these localities.
	Yalesville.	Westville.	Southington.	New Haven.	
Lime, Sulphur and Salt, Formula No. 1	91	93	95	96	94.5
" " " No. 2	92	--	--	--	--
Lime and Sulphur	98	88	96	..	94
Lime, Sulphur and Copper Sulphate	--	--	--	70	--
Lime and Sulphide of Potash	--	91	97	--	94
Strong Bordeaux Mixture	--	85	--	..	85
Whitewash	--	72	70	--	71
Twenty-five per cent. Crude Oil in water	--	100	--	--	--

Other Experiences.

Several small trees including peach, cherry, pear, Japan plum, and hawthorn in a New Haven city garden were sprayed with the lime, sulphur and salt mixture on January 19th.

The mixture was boiled in a kettle on the kitchen range and applied thoroughly. Though the mixture seemed to become well dried upon the trees, a heavy rain fell on the 21st and it washed off badly. Two months after applying, no traces of the spray could be seen on the trees, and a very large proportion of the scales were not killed, as the trees were very badly infested during the latter part of the summer.

In another yard six small trees, including quince, pear, apple and peach, were sprayed on March 18th, with the lime, sulphur and salt mixture.

Though some of the trees were quite badly infested, the treatment seems to have been successful, as very few living scales could be found when the trees were examined on September 15th.

Considerable spraying with the lime, sulphur and salt mixture was done in the large orchards of the state. George F. Platt & Son of Milford sprayed 8,000 peach trees last spring just before the buds started, at a cost of two cents per tree. While the results were generally satisfactory, many scales survived and multiplied rapidly during the season on account of unfavorable weather and high winds at spraying time. The owners intend to spray the orchard again as soon as the leaves fall this autumn.

Mr. J. H. Hale of South Glastonbury sprayed about 11,000 trees with the mixture, with satisfactory results.

N. D. Platt & Son of Milford sprayed about 800 six-year-old peach trees at a cost of about six cents per tree. The results were successful.

Mr. N. H. Sherwood of Southport sprayed his entire orchard of 2,200 peach trees with lime, sulphur and salt with satisfactory results.

One grower of West Hartford sprayed a few trees, using 150 gallons of the mixture. The work was satisfactory, as nearly all of the scales were killed. The treatment will be repeated next season. Another West Hartford peach grower reported that 1,000 of his trees were sprayed with the mixture during early spring with successful results in killing the scale. 1,000 trees were sprayed in Cromwell, and many other growers have each used the mixture on a smaller number of trees.

In the orchard of the Highland Fruit Co. at Wallingford, 1,200 five-year-old peach trees were sprayed with 25 per cent. crude oil in the spring of 1903. The work was done thoroughly, the results were satisfactory, and the cost was three cents per tree on the average.

Mr. Linus H. Hall of Wallingford reports that 1,200 large trees in his orchard have been sprayed for two seasons with 25 per cent. crude oil. The average cost was three and one-half cents per tree for each treatment, and the results were fairly satisfactory.

Mr. Z. P. Beach of Wallingford has done more or less spraying with 25 per cent. crude oil each year for three years in his orchard of 4,500 peach trees, all of the trees being sprayed in 1902. The scale has been held in check and only a few trees injured by the oil.

SUMMER SPRAYING WITH KEROSENE EMULSION.

After it was found that the whitewash applied to the peach trees at Southington had proved unsuccessful in destroying the scale-insects, kerosene emulsion was applied on August 10th, to kill the young and prevent to some extent the very rapid multiplication of the scales for the season.

As the pumps for making a mechanical emulsion were not in working condition, it was necessary to prepare a soap emulsion. Two formulas were employed:

No. 1.	½ lb. common soap 2 gallons kerosene 28 gallons water	6.6 per cent. kerosene.
No. 2.	¾ lb. common soap 6 gallons kerosene 34 gallons water	15 per cent. kerosene.

In each case the soap was dissolved in hot water, the oil added, and the whole churned violently for a short time until a white creamy mass formed, which was then diluted and applied.

Fourteen trees were sprayed with emulsion made from formula No. 1, and eighty-six trees with formula No. 2. No injury was done to the trees except possibly the dropping of a few leaves, but this was scarcely perceptible.

The results of this summer treatment were unsatisfactory. Though a large number of insects were killed, many came through alive and when the trees were examined on September 9th the young were numerous on these trees. Formula No. 1 killed about half the scales and formula No. 2 killed from two-thirds to four-fifths of them. But enough escaped to keep the trees badly infested.

MAKING THE LIME, SULPHUR AND SALT MIXTURE.

The materials needed for making the lime, sulphur and salt mixture are: good fresh stone lime (the best grade finishing lime), sulphur flour, or the sublimed flowers of sulphur, and a cheap grade of salt. The agricultural or hay salt is commonly used.

While the operation is quite simple, much care should be used in making the mixture. We found that small quantities, sufficient to spray one or two hundred trees, could be boiled nicely over a fire in a set kettle, such as is used to heat water and cook feed for stock on many of the farms.

For making large quantities, however, it is necessary to boil it by steam from a boiler. Where a boiler is handy, it is an easy matter to procure the necessary barrels for holding the mixture and the hose to carry the steam from the boiler to the barrels. Often one can hire a small portable boiler for the occasion. Where spraying is done on an extensive scale, plants have been established for cooking the mixture in large quantities.

In whichever way the mixture is made, the process is similar and the same care should be taken in preparing it.

The formula used chiefly in our experimental work was 20 pounds lime, 14 pounds sulphur and 10 pounds salt to 40 gallons water. This is simply two-thirds the amount of the 30-20-15-60 formula, and is more convenient, as it just fills a barrel.

The lime should be thoroughly slaked. Much of the trouble in straining and also the clogging of the pumps is caused by the improper slaking of the lime.

The sulphur and salt are then added and the whole boiled for an hour or an hour and a half. The mixture should be kept well stirred all the while it is boiling; while the sublimed flowers of sulphur is more soluble than the sulphur flour, it is liable to form in lumps, which must be crushed against the sides of the kettle or barrel, and consequently it will be necessary to boil it as long as it will the sulphur flour.

After boiling, add water to make the right proportion.

The mixture should be strained through a strainer having about twenty meshes to the inch.

If the mixture has been thoroughly prepared, very little sediment will remain, and there will be no trouble from clogging the nozzles.

The pumps should be thoroughly cleaned every night after spraying. It has been recommended to run a little vinegar or some weak acid through the pump to neutralize the effects of the alkaline solution.

All receptacles should be iron or wood, the strainer iron or brass, and under no consideration should copper be used.

On May 12th, a piece of copper wire weighing 4½ grams was boiled for one hour in the lime, sulphur and salt mixture. During this time the weight had been reduced to 3½ grams by the corrosive action of the mixture. In standing three hours after boiling the weight was further decreased two-fifths of a gram.

At the same time brass wire weighing 6½ grams was boiled for one hour in the same kind of mixture with no decrease in weight.

The metals were allowed to stand in the mixture and were examined about September 1st. The brass was slightly corroded, but no trace of the metallic copper could be seen.

Laboratory tests were made with the different grades of sulphur, light sulphur flour, heavy sulphur flour, and flowers of sulphur. The two grades of flour are simply ground brimstone, the "light" being more finely ground than the "heavy." Flowers of sulphur is a sublimated product and the particles are smaller and of different shape than in sulphur flour, and can be readily distinguished under the microscope.

135 grams lime, 90 grams sulphur, and 68 grams salt were the quantities used in the test.

A contained heavy sulphur flour.
B contained light sulphur flour.
C contained flowers of sulphur.

The lime was slaked in each case and one-half pint of hot water added. C was the first to show discoloration due to chemical action. Each boiled at 102° C. After boiling for half an hour a half-pint of hot water was added to each. After boiling one hour, a preliminary test for sulphur was made. A, contained considerable, B, a very small quantity, and C, no undissolved sulphur.

The flowers of sulphur costs a little more than the sulphur flour, but is not so heavy.

Flowers of sulphur weighs	175	pounds	per barrel.*
Sulphur flour (light) "	225	"	" "
" " (heavy) "	275	"	" "

---

* These weights were given us by a local wholesale drug firm, but we have recently purchased flowers of sulphur put up in barrels of 150 pounds each.

The sulphur can be made into a paste before adding, may be slaked with the lime, or may be sifted upon the top of the liquid to avoid lumps.

Finishing lime is preferable as it is nearly pure lime, slakes completely, and contains less dirt than other grades. The lime used in the Southington experiments contained only 54.24 per cent. of lime and 36.04 per cent. of magnesia.

Making the Lime and Sulphide of Potash Mixture.

Sulphide of potash is commonly known as "liver of sulphur" and is sold by all druggists. It comes in the form of light yellowish brown lumps, and is put up in pound, five pound, and ten pound packages. Larger packages can doubtless be obtained if desired. It is readily soluble in water and the right quantity by weight should be dissolved in a barrel, pail or basin. The lime should be slaked in a separate receptacle and when both substances are in liquid form, put them together and add water to make the right proportions. In our experiments, twenty pounds each of lime and sulphide of potash to forty gallons of water were employed and the results were about as satisfactory as where the boiled mixture was used. The disadvantage of this mixture lies in the cost of the sulphide, making it too expensive for orchard spraying. It is very convenient, however, for a few small trees or shrubs in the village garden, and may be prepared by taking one pound each of lime and sulphide of potash to a pail of water.

Effect of the Lime and Sulphur Mixtures on the Skin.

The lime, sulphur and salt mixture is very irritating to the skin and causes smarting, and finally soreness if the spray is allowed continually to come in contact with the hands and face. Gloves should therefore be worn to protect the hands. For this purpose rubber or oil-skin is preferable. The mixture quickly ruins leather. Cheap masks may be used to protect the face, though this is hardly necessary if the operator keeps on the windward side of the tree when spraying.

Rubbing the face and hands with petrolatum before commencing work is also advisable.

WEATHER NOTES.

One of the greatest drawbacks to using the lime, sulphur and salt mixture in the east is the rainy weather, early in spring common to this section. If the application is followed by a week or more of clear weather, the mixture is doubtless more effective than if rains occur soon after it is applied.

The mixture should at least have time to thoroughly dry upon the trees before it rains.

Notes were kept regarding the weather following our spraying experiments in March and April.

At Southington trees were sprayed on the 27th and 28th of March. About four o'clock on the afternoon of the 28th a brisk shower stopped the work. The 29th was clear. It rained the afternoon of the 30th and hard all night, followed by showers the 31st.

The first of April being a pleasant day, we sprayed at Westville. The 2d was clear and windy. It rained nearly all day the 3d, the 4th rain and snow. The 5th and 6th pleasant weather prevailed. The 7th and 8th were rainy, and in the evening of the 9th there was a heavy shower. From the 10th to the 14th was pleasant. The 15th and 16th were stormy. From April 17th to the 28th of May no rain fell, excepting May 4th, when we had a light shower that scarcely laid the dust.

For about three weeks following the spraying there was considerable rain, which washed much of the mixture from the trees, and doubtless affected somewhat the results of the experiments.

SUMMARY.

1. During the Spring of 1903, spraying experiments were conducted in Yalesville, Westville, Southington and New Haven, over 11,500 trees being treated. The trees were chiefly peach, pear and apple.

2. The chief mixtures used were: lime, sulphur and salt; lime and sulphur; lime, sulphur and copper sulphate; lime and potassium sulphide; whitewash; strong Bordeaux mixture; twenty-five per cent. crude oil in water, upon dormant trees, and kerosene soap emulsion upon trees in foliage.

3. Most of the trees were sprayed with the lime, sulphur and salt mixture (California wash): this and the lime and sulphur mixture, and the lime and potassium sulphide proved about equally effective in destroying the scales and in sticking to the trees. Apparently the salt is of no benefit either in making the mixture more destructive to

the scales or in rendering it more adhesive to the trees. Whitewash and strong Bordeaux mixture as used in these experiments were unsatisfactory scale-destroyers. The former soon disappeared from the trees while the latter remained about as long as the lime and sulphur mixtures. The Oregon wash (lime, sulphur and copper sulphate) soon disappeared from the trees, though in one case it was quite destructive to the scale-insects. Twenty-five per cent. crude oil in water must be regarded as an excellent scale-destroyer. Though no injury resulted to the trees in these experiments, many trees have been damaged here and in other states, and it is hardly a safe treatment for the average orchardist to use; but the oil mixtures have greater penetrating power than any of the lime and sulphur mixtures, and therefore may be expected to destroy a larger proportion of scale-insects on badly infested trees.

4. Several Connecticut orchardists have sprayed their orchards (containing nearly 40,000 trees) with the lime and sulphur mixtures with generally satisfactory results. Several thousand trees have also been sprayed with oil, with good results, though trees were injured in some cases.

5. The lime and sulphur mixtures remained upon the trees longest when applied just before the leaves appeared, being protected by them. In some cases it washed off and was not effective when applied in the winter.

In orchards where two applications were made (one in late fall and the other in early spring) it was difficult to find any living insects in June.

6. Kerosene emulsion as a summer spray was not particularly successful in our experiments.

POSTAL CARD BULLETIN ON THE SAN JOSÉ SCALE-INSECT AND THE ELM LEAF BEETLE.

The postal card bulletin is a convenient form in which to send out short statements of timely information. The following was issued in February in an edition of 11,000 copies:

POSTAL CARD BULLETIN.

This bulletin is not numbered or distributed with the regular bulletin series.

CONNECTICUT AGRICULTURAL EXPERIMENT STATION,
NEW HAVEN, CONN., February 2, 1903.

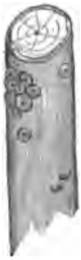

FIG. 32. The San José Scale-Insect.

SAN JOSÉ SCALE-INSECT. Now is the time to spray orchards, trees and shrubs to kill the San José Scale-insect. Destroy all worthless trees, prune the others, cutting them back severely if badly infested, and spray thoroughly with the lime, sulphur and salt mixture, which is prepared as follows: Slake 30 pounds fresh stone lime, add 20 pounds flowers of sulphur and 15 pounds common salt; cover with water and boil for at least one hour over a fire or with steam from a boiler. Then add water to make 60 gallons and spray while fresh upon the dormant trees.

Twenty-five per cent. of crude oil mixed with water in a "Kerowater" pump may be used for the same purpose, but is liable to injure the trees, and should not be applied until just before the buds start.

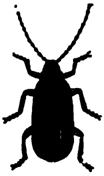

FIG. 33. The Elm Leaf-Beetle.

ELM LEAF-BEETLE. Adult beetles are now hibernating in the towers of public buildings, belfries of churches, and attics of dwellings—in fact, in any building where they can find protection. These beetles are now in a dormant condition, but will become active in March and April, flying to the elms as soon as the leaves appear, and beginning anew their depredations. The beetle should not be confounded with the two-spotted red lady-beetle that hibernates in similar places, and which is a beneficial insect. By cleaning out all such places and destroying the beetles during the next month much can be accomplished toward preventing injury to the elm trees next summer.

W. E. BRITTON, *State Entomologist.*

THE GREEN APPLE LEAF APHIS.

Aphis pomi De Geer.

The apple leaf plant louse or aphis was remarkably abundant in 1903. The long period of dry weather in spring was doubtless favorable for the development of plant lice and they increased with great rapidity. Throughout the state orchards were considerably injured; the growth being checked by the thousands of plant lice which sucked the sap from the tender shoots and leaves. In most cases this aphis attacks the under side of the leaves, causing them to curl and appear as shown on Plate VI, a. Not only were orchard trees attacked, but the apple stock generally in the nurseries of Connecticut was below the usual size, on account of the injuries caused by this insect. Most nurserymen did not attempt to kill the lice on their nursery trees, though Barnes Brothers of Yalesville used kerosene emulsion rather extensively. The tops of the trees were bent over and dipped into the liquid.

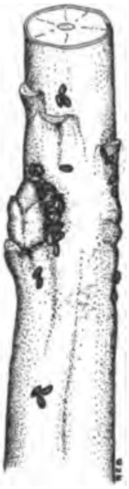

FIG. 34. Eggs of green apple aphis as they appear on the twigs in winter.

The apple tree is attacked by several species of plant lice which have been greatly confused by various writers. Professor E. Dwight Sanderson, now State Entomologist of Texas, but formerly Entomologist of the Delaware Experiment Station, has recently made a study of the subject, and has described and named a number of new species.* The bibliographies given in Professor Sanderson's paper show that at least two species have very generally been known as *Aphis mali* Fabr., and a third, *A. sorbi* Kalt., has several times been included under the same name. Sanderson also shows that *A. mali* Fabr. is a synonym of *A. pomi* De Geer. One of the best accounts of the apple plant louse (as *Aphis mali*) that has appeared in recent years is given by Professor J. B. Smith† of New Jersey. Both Professor Smith and Professor Sanderson have followed the development of the insect through its different stages and generations. The present writer has not been able to do this, but the figures and the descriptions of the mature forms here given have been taken from material gathered upon the Station grounds in July. The notes on the immature forms and life history have been taken from the writings of Smith and Sanderson.

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* 13th Report Delaware Agr. Exp. Station for 1901, page 127.
† Bull. 143, New Jersey Agr. Exp. Station, 1900.

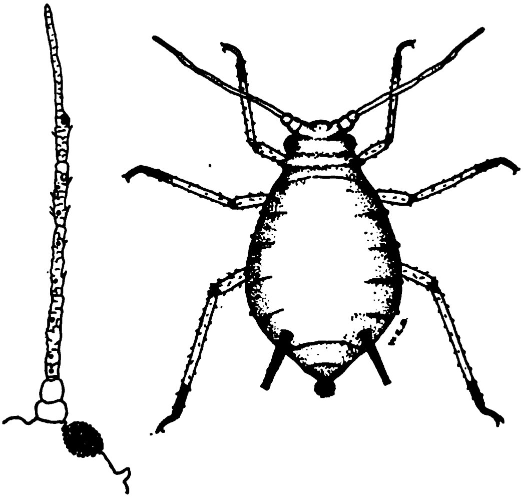

FIG. 35. The green apple aphis *A. pomi*. Wingless viviparous female, enlarged. Antenna, still further enlarged, is shown at left.

Appearance and Life History.

Though usually green, a bright yellow form of this species occurs on the apple. The green apple-leaf aphis can usually be distinguished from the other species found upon the apple by its long and straight, black, tapering cornicles or honey tubes. The species occurs in Europe, where it has been described by Kaltenbach, and it is doubtless common throughout the United States.

This species passes the winter in the egg stage upon the twigs of apple trees. The eggs are oval in shape, black, and shiny, and have the appearance shown in Figure 34. They are usually placed around the buds, in crotches, or crevices of the bark.

These eggs hatch in April, but according to Sanderson, the lice are not common on the buds and are seldom abundant until after the foliage is well out in May. The lice are then found on the under surface and cause the leaves to curl badly, as shown on Plate VI, a. The lice are found upon the apple tree throughout the season, though the winged females of the second brood are said to migrate to other apple trees. Ten or more generations are produced each season, seven of which are parthenogenetic females. In October a sexual generation is developed and the females lay eggs for the following season. Egg-laying may be kept up until the middle of November, or further south until December.

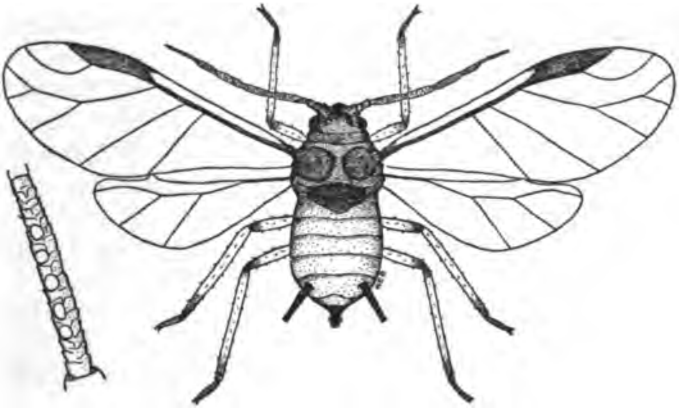

Fig. 36. The green apple aphis *A. pomi*. Winged viviparous female, enlarged. At the left may be seen the third joint of the antenna with sensory pits—very much enlarged.

The wingless viviparous female is of a yellowish green color, with lighter-colored legs and antennæ; Cauda, cornicles, tarsi, knees and distal extremities of tibiae, dark. Body pyriform in shape, with cornicles or honey tubes long, reaching to the end of the abdomen, and tapering. See Figure 35.

The winged viviparous female is less than a tenth of an inch in length and has a wing expanse of about one-fourth of an inch. The body is somewhat darker in color than in the wingless form. The head and raised portions of the thorax are dark brown or black. Cauda, cornicles, knees, tarsi and distal third of the tibiae are brown or nearly black. Honey tubes long and tapering. See Figure 36.

Remedies.

Thorough and persistent spraying with soap and water or with kerosene emulsion is necessary to keep the apple leaf aphis in check. The few that escape death multiply so rapidly that the branches are again soon covered.

Natural enemies were surely at work, as the writer saw an abundance of lace-winged flies (*Chrysopa*) and several kinds of lady-beetles feeding upon the lice. Of the lady-beetles, the two-spotted lady beetle, *Adalia bipunctata,* seemed to be the most common. Larvæ of *Syrphus* flies were also abundant, and destroyed large numbers of the plant lice.

On May 6, a few tests were made of the effectiveness of soap and water in killing this aphis. The following records were taken from Mr. Walden's note book. In all cases the infested branches were dipped into the mixture.

1 lb. soap in 8 gallons water. Examined May 8, and found nearly all lice killed. The few living ones might have crawled from below the dipped portion.

1 lb. soap in 6 gallons water. Only a few living insects on May 8. Number somewhat smaller than in preceding.

1 lb. soap in 4 gallons water. Nearly as many living insects as where the weaker mixtures were used.

During the winter of 1902-3 the eggs were abundant on apple twigs.

We expected to find them also the following winter after their very great abundance and injury to the trees through the season, but examination of apple trees in and near New Haven shows, on the contrary, that the eggs are scarce. This indicates that the species may be less abundant the coming season.

THE PEAR PSYLLA.

Psylla pyricola Först.

The pear psylla, which has been so abundant the past season, has been known for a long time in Connecticut, and it is interesting to note that the insect first made its appearance in the United States in this commonwealth. It is believed to have been introduced from Europe upon young pear trees imported by Dr. Ovid Plumb of Salisbury, in 1832 and during the five years following, several hundred trees were killed by this insect.

In 1848 the insect was known to be present in Massachusetts and New York. In 1871 considerable injury was caused by it in New York and Illinois, and again in 1879 it was destructive in New York State. It was not until 1891, however, that the insect became generally abundant and destroyed many trees in Massachusetts, Connecticut, and Maryland. Since then the insect has appeared in many other states, and it is doubtless distributed throughout the northern states east of the Mississippi river. Many orchards have been so seriously injured that the crop has been a failure and hundreds of trees have been killed outright.

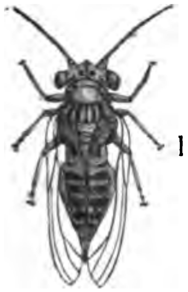

FIG. 37. Pear psylla, adult insect, considerably enlarged.
(After Slingerland, Cornell University Exp. Station, Bull. 44.)

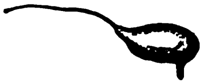

FIG. 38. Egg of pear psylla, much enlarged.
(After Slingerland, Cornell University Exp. Station, Bull. 44.)

In the season of 1892, Professor M. V. Slingerland of Cornell University made a careful study of the pear psylla, and the facts connected with the early history and life of the insect are taken from his admirable bulletins.*

Relationship to Other Insects.

The pear psylla belongs to a group of insects known as jumping plant-lice, which form the family *Psyllidae*. These insects are closely related to our common aphides, or plant lice, but the adults have the habit of jumping like fleas.

According to a paper by C. W. Mally,† there are about thirty-five species of this family in the United States.

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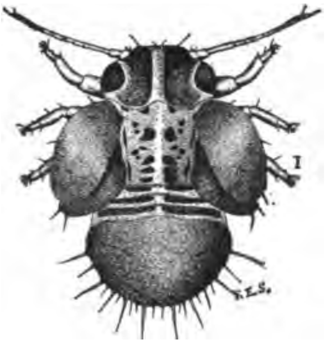
* Bulletin 44, Cornell Exp. Station, 1892.
Bulletin 108, Cornell Exp. Station, 1896.

† *Psyllidæ* found at Ames, Iowa, Proc. Iowa Acad. of Sciences, Vol. II., p. 152, 1894.

How the Pear Psylla Injures Trees.

Belonging to the order Hemiptera and being a near relative of the plant lice, the pear psylla, like its allies, feeds by sucking the sap or juices from the pear tree. The soft and succulent tissues are evidently preferred and the leaves and new shoots are, therefore, most commonly attacked. Like the plant lice and scale-insects, the psyllids give off "honey dew," which during the past season was very abundant, on account of the large number of insects, and dripped upon the ground and lower leaves of the trees. The "honey dew" makes the leaves appear as if they had been varnished and a black mold (*Fumago*) grows in the "honey dew" giving the trees a blackened or scorched appearance.



Fig, 39. Pear psylla, nymph, considerably enlarged. (After Slingerland, Cornell University Exp. Station, Bull. 44.)

The injury probably comes chiefly from the minute punctures and the loss of sap. Many trees shed their leaves in July, the lower leaves being the first ones to turn yellow and drop. The young fruit also falls from badly infested trees, such trees make little growth, and sometimes new shoots are attacked and wither early in the season.

Appearance and Life History.

The adult insect is about one-tenth of an inch in length and somewhat resembles a miniature cicada or dog-day harvest fly. It is shown in Figure 37. The egg (see Figure 38) is about one-eightieth of an inch long and scarcely perceptible without the aid of a magnifying glass. It is pear-shaped with the small end drawn out into a long thread-like appendage. The larger end is attached to the twig by a short stalk. The eggs are laid in the crevices of the bark or around the buds about the middle of April. These eggs hatch in about three weeks, and the young nymphs gather in the axils of the leaves, and later on the leaf-blades, young fruit, and tender shoots, where they suck out the sap. The nymphs are not very active and unless disturbed move about but little. I have seen many that were almost buried in their own "honey dew." The nymphs molt several times (probably five) and become adults in about one month after hatching from an egg.

According to Slingerland* there are at least four broods each year and probably sometimes five in Maryland. The eggs of the summer broods are laid upon the leaves and have the same appearance as those laid upon the twigs in April.

The nymph or immature insect is at first yellow in color but as it grows takes on a reddish tint and black markings. The full-grown nymph has conspicuous black wing-pads and is shown in Figure 39.

The insect passes the winter in the adult stage on the pear tree, in cracks of the bark and scars where branches have been removed.

Natural Enemies.

Our common lace-winged fly *Chrysopa oculata* and our commonest lady-beetle, the "two-spotted" species, *Adalia bipunctata,* are known to feed upon the pear psylla.

Remedial Treatment.

Slingerland reports that the eggs are difficult to destroy and that many hatched after having been dipped into kerosene. The young nymphs, however, were readily destroyed by kerosene emulsion. In our own tests common soap and water (1 lb. dissolved in 4 gallons water) destroyed the nymphs and many of the adults. The chief difficulty lies in the fact that many of the nymphs are partially or wholly covered by "honey dew" so that they are not reached by the insecticides. It is recommended, therefore, that where possible the application should be made directly after a rain, which washes off the "honey dew." Probably the most vulnerable point in the life history of the insect is during the latter part of April, soon after the first lot of eggs hatch. The young nymphs are readily destroyed, and at this time "honey dew" is much less abundant than later in the season. But in April the grower does not expect that the insect will be especially abundant or do much injury, so does not spray. During midsummer, when the young fruit and leaves are falling, he realizes that something must be done. Even at this late hour the ravages of the insect may be checked in large measure by a thorough spraying with soap and water, or kerosene emulsion.

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* *Loc. cit.*

THE ONION THRIPS.

Thrips tabaci Lindeman.

In the Report of this Station for 1889, p. 180, Dr. Roland Thaxter, then Mycologist of the Station, published this note: "The white blast of market onions is the most serious disease to which onions in the field have been subjected this year, and has been reported from numerous localities and observed in all the onion districts which have been visited. The injury gives the field a whitish appearance, which starts in one or more spots and spreads in all directions. The onions themselves become stunted in their growth, while the leaves are more or less completely dying, according to the severity of their attack; becoming water-soaked at the base if the weather be at all wet, inducing decay, and generally injuring the keeping quality of the bulbs."

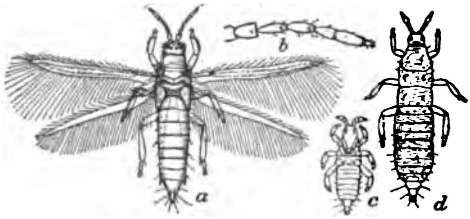

FIG. 40. The onion thrips *Thrips tabaci*. *a*. adult female; *b*. antenna of same; *c*. young larva or nymph; *d*. full grown larva. All enlarged.
(After Howard, Division of Entomology, U. S. Dept. of Agriculture, Yearbook for 1898.)

The above description applies very well to the appearance of a three-acre field of onions in Highwood when the writer visited the place on July 24. This field has already been mentioned on page 213 of this Report. At this time the insects had spread over the entire field and the tops of the plants were nearly all white.

The owner said that he should not bother to spray the plants, though soap and water was suggested as an insecticide. And it was probably not worth while to attempt to save the plants as they had been so seriously injured.

As the onion thrips is a serious pest of the onion crop in Connecticut, and as considerable attention is given this crop in the State, a short account of the insect here may be of some help to the growers.

Mr. Pergande, who has published "Observations on Certain *Thripidae*,"* states that the earliest record that he could find of this insect injuring onions was made by Dr. A. S. Packard in 1872,† while entomologist to the Massachusetts Board of Agriculture. In Packard's paper it is stated that the injuries to the onion crop caused by this insect amount to $10,000 annually in Essex county alone.

Gillette gives an account‡ of thrips that had attacked onions in Colorado in 1892 and 1893 and which he supposed to be a new species, suggesting the name of *Limothrips allii* for it. This species was later described by Miss Beach, who placed it in the genus *Thrips*. The specific name suggested by Gillette was used in Bulletin 83, new series of the New York (Geneva) Agricultural Experiment Station in 1894.

After comparing material of this species with European specimens of *Thrips tabaci* Lindeman, Mr. Pergande finds the supposedly different species to be identical, and Lindeman's name must stand.

The adult female is only about one millimeter in length, of a pale yellow color with darker wings; legs and antennæ. The male greatly resembles the female but is smaller and without wings. The antennæ are seven-jointed. See Figure 40. The larva is smaller than the adult female, without wings, and with six-jointed antennæ. The immature larva is shown on Plate VI, b.

This insect is also known to feed upon cabbage, cauliflower, kale, turnip, melons, pumpkin, squash, cucumber, tobacco, tomato, wheat, and many kinds of flowering plants and weeds.

The species was recorded as an enemy of tobacco by Targioni-Tozzetti§ in 1891, and Howard mentions it in his article on tobacco insects,* but states that it has never been found upon tobacco in this country. The most recent account of the insect is given by Hinds in his excellent monograph of the order.†

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* Insect Life, Vol. VII, p. 390.

† Second Annual Report on the Injurious and Beneficial Insects of Mass., p. 5.

‡ Bulletin 24, Colorado Agr. Exp. Station, p. 13, and Rept. of the same Station for 1893.

§ Animali ed Insetti del Tobacco, p. 222.

The remedies usually recommended are, spraying with kerosene emulsion or soap and water, except in green-houses where tobacco fumigation often serves to hold the insect in check. This proved satisfactory in case of an allied species, *Heliothrips femoralis* Reuter (*cestri* Perg.), that attacked forcing-house‡ cucumbers at this Station a few years ago.

The various species of thrips injure plants by puncturing the green portions and sucking out the sap. The cells thus emptied of their contents become white and shrivelled, thus suggesting the name "white blast" applied to the trouble by the onion growers.

AN INTERESTING LUMINOUS INSECT.

On June 12 the writer received from Prof. W. R. Coe of Yale University a large luminous larviform insect which had been found at Mt. Carmel by Mr. R. D. Gilbert. Though the specimen greatly resembled a larva, it was probably the female of a species of *Phengodes*. Very little is known about the species of this genus especially the females, except that they are among the most striking and beautiful of all luminous insects. It was formerly supposed that these females were the larvæ of certain species of click-beetles (family *Elateridæ*), and in the fifth Report on the Noxious and Beneficial Insects of Illinois, by Wm. LeBaron (LeBaron's 4th), page 99, there is published one of Riley's figures in which the luminous female is shown as the larva of *Melanactes piceus* De G. The same figure was used by Dr. Riley in the American Entomologist, page 202, and labeled "A luminous elaterid larva." The specimen collected by Mr. Gilbert so closely resembled Riley's figure that I have herein reproduced it in part, omitting the elaterid beetle which was originally a portion of the figure. See Figure 41.

On July 8, a similar but much smaller specimen was received from Mrs. C. H. Lyman, Jr., of Waterbury. I was unable to determine whether this was a different species or only a younger example and possibly the true larval form of the same species. Both specimens were kept for a time and fed upon small earth worms which were provided them. Several myriapods were given them but they were evidently not the right kind and were not eaten. Both died before the end of the summer and neither specimen molted nor transformed while in captivity.

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* Principal Insects Affecting the Tobacco Plant, Year-Book U. S. Dept. of Agriculture for 1898, p. 142.

† Contribution to Monograph of the Insects of the Order Thysanoptera, Inhabiting North America, Proc. U. S. Nat. Museum, Vol. XXVI, p. 79, 1902.

‡ Report Conn. Agr. Exp. Station for 1896, p. 244.

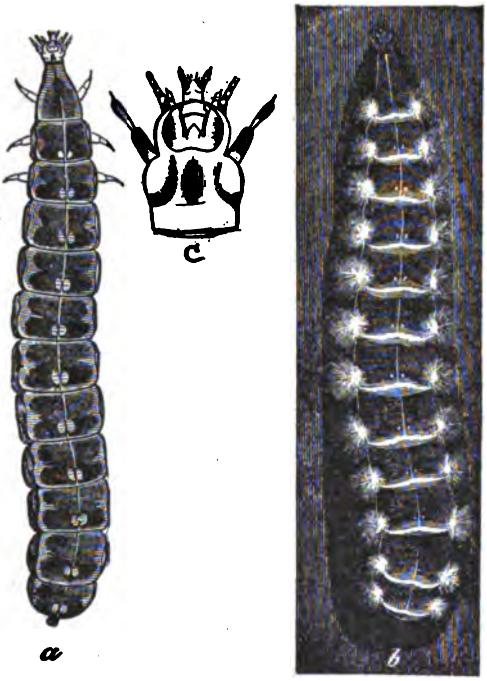

FIG. 41. A luminous insect, probably *Phengodes laticollis*. *a*. appearance in daylight; *b*. appearance in darkness; both natural size. *c*. head of same, enlarged. (After Riley.)

The specimen from Mt. Carmel was probably the adult female and was nearly three inches in length, and nearly one-half inch in thickness in the middle, from which the body tapered in both directions, though but slightly, towards the posterior extremity. The anterior portion tapered considerably to the head, which was small and retractile. Twelve segments, beside the head, made up the body. The body was cream-colored or light yellowish brown, with a slightly darker band along each side and a narrow line along the back. Beginning on the second thoracic segment, each segment has a pair of oval spots, one either side of the median line. The posterior margin of each segment was somewhat lighter in color than the other portion, and in the dark this margin appeared as a luminous cross-band. Along the side of the body each segment bears a luminous spot from which a greenish white light radiates, as shown in Figure 41. This is undoubtedly the most brilliant and handsome of all the glow-worms. The light was sufficiently bright to enable one to read the coarse print of newspapers. Several attempts were made to photograph this insect by its own light but without success. After long exposure only a feeble image was made on a very sensitive plate. The insect was placed in a box in the dark room with a sensitive plate three inches from the object. After an hour's exposure the plate was only very slightly affected, showing that the light is quite non-actinic.

In 1886, Dr. Riley read a paper before the Washington Entomological Society,* stating his conclusion that the luminous larvæ which had previously been referred to the *Elateridæ*, belonged to the *Lampyridæ* and to the genus *Phengodes*. The next year further notes were presented† regarding the pupation and egg-laying of one of these larviform females.

One of the most interesting accounts‡ of observations upon these curious insects is from the pen of Prof. G. F. Atkinson, now of Cornell University, but formerly botanist and entomologist of the South Carolina Experiment Station. Atkinson describes the female of *Phengodes laticollis* Lec. which he kept in captivity for a long time, and which fed upon *Polydesmus canadensis*. On May 19, males were collected after they had visited the females. These males were only about three-fourths of an inch in length and were not luminous. The females laid yellowish eggs, which were also luminous before hatching. The eggs from one female were not fertilized and therefore did not hatch; the other female deposited fertile eggs which hatched in thirty days.

Prof. J. B. Smith states§ that the larvæ and females of *Phengodes* are among the most brilliant of all our forms and are very rare.

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* Proc. Ent. Soc. of Washington, Vol. I, p. 62.
† Idem, Vol. I, p. 86.
‡ Report, South Carolina Exp. Station, 1888, p. 48.
§ Insects of New Jersey, p. 261.

Many of the *Lampyridæ* are considered beneficial as they feed largely upon insects or other forms of animal life.

THE IMPORTED CABBAGE BUTTERFLY OR CABBAGE WORM.

Pontia (*Pieris*) *rapæ* Linn.

The chief insect enemy of the cabbage in Connecticut, and in fact in the northeastern United States, is the imported cabbage worm, *P. rapæ.* The white butterflies may be seen flying about every garden on bright summer days, and the caterpillars may be found feeding upon cabbage and cauliflower wherever these vegetables are grown. The species was introduced into America from Europe in 1858, by way of Quebec, and it has since spread over the entire United States. Formerly a native species, *Pontia oleracea,* attacked the cabbage crop in the northern states, but this species is now very rare and as a cabbage pest has been almost entirely superseded by the imported species, *P. rapæ.*

The cabbage butterfly is yellowish white in color with body and tips of the fore wings black, and a black spot in the center of each fore wing and on the front edge of each rear wing. The egg is a small cone-shaped object fastened by the base to a leaf of the cabbage, mustard or some allied plant. In about six days the egg hatches and the young worm or larva, after devouring the egg-shell, spins a small web upon which it rests while feeding. In about ten days, during which time the worm has been feeding energetically and has molted three times, it becomes full grown and crawls under a board or fence rail and forms a chrysalis. The chrysalis is often found suspended by a silken thread to the under side of fence rails, clapboards of buildings, etc.

About twelve days are required for the transformations to take place in the chrysalis, then the butterfly emerges. The caterpillars feeding upon a cabbage leaf, chrysalis and adult all natural size, are shown on Plate VII.

In northern New England there are three broods each year, and according to Lowe and Sirrine* there are at least four, and possibly five, broods each year on Long Island. The winter is supposed to be passed in the pupa or chrysalis stage.

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* Bulletin 83, New Series, New York (Geneva) Agr. Exp. Station, p. 658.

It has been estimated that this insect causes an annual loss of about one million dollars in the vicinity of New York City.

The chief remedy used by truck growers is to spray or dust young plants with Paris green. As the cabbage plant grows from the inside in heading, there is little danger of its being poisoned even after the head is formed if the outer leaves are removed before cooking or using. But in the home garden, the worms may be suffocated by blowing upon them some fine dust like road dust, Pyrethrum, hellebore, or air-slaked lime. They may also be killed with hot water, kerosene emulsion, or soap and water.

THE NATIVE CURRANT BORER.

Psenocerus supernotatus Say.

Each season a number of currant stems have been killed at the Station by this beetle, though the damage is not very great because new canes are produced freely. Growers do not seem to be very familiar with this enemy, however, and a short account of it is given here for the purpose of acquainting them with the chief facts in its life history.

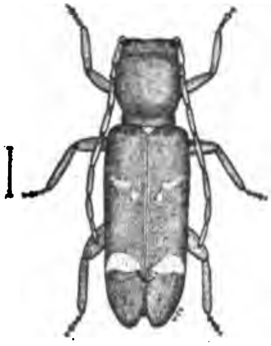

FIG. 42. Native currant borer *Psenocerus supernotatus*. Adult insect. × 6.

We have two different borers attacking the currant. Besides the beetle just mentioned, the imported currant borer (*Sesia tipuliformis* Linn.), the adult of which is one of the clear-wing moths, occasionally is sufficiently abundant to do considerable injury.

On May 27, the writer noticed that many shoots in the currant plantation were not healthy. Some were even dead, though in leaf, others showed yellow leaves, and in many cases the foliage had wilted. On cutting, examination showed that these canes were tunneled lengthwise through the pith, the tunnel in some cases extending up and down the stalk for several inches. Some of the tunnels were empty with an exit-hole where the borer had escaped. No larvæ were seen, but living pupæ were found in the burrows, and in one an adult beetle. The pupa in each case was near the exit or mouth of the burrow, and is about a quarter of an inch long, and brown in color. Photographs of some of the specimens, together with the injured currant stalks, are shown on Plate VIII. The beetle is very small, being about one-fourth of an inch in length, narrow, and dark brown in color marked with white spots as shown in Figure 42. This beetle belongs to the family of long-horned beetles (*Cerambycidæ*) which includes many of the large-sized borers.

The only known remedy is to cut and burn the infested stalks, and this should be done as soon as they appear sickly, in order to destroy the borer before it escapes from the stalk.

ENTOMOLOGY IN THE REPORTS OF THE CONNECTICUT BOARD OF AGRICULTURE.

As Connecticut was one of the first states in the Union to establish and maintain a Board of Agriculture, and as the Reports of this Board form a series of volumes from 1866 to the present time, except in 1870, when the Board was abolished by act of the legislature, but reorganized the following year, considerable interesting matter regarding the early appearance of injurious insects in the state may be looked for in the Reports of this Board.

The Station library contains a complete set of these Reports. Thinking that a list of the entomological references might be of some value to entomologists, especially regarding the historical side of economic entomology, I have asked Mr. Walden to prepare such a list, which is here published. It also contains one or two references to the Transactions of the Connecticut Agricultural Society, which preceded the reports of the Board of Agriculture. Three volumes of the Transactions are in the Station library.

REFERENCES TO ADDRESSES AND NOTES CONCERNING INSECTS, IN THE REPORTS OF THE CONNECTICUT BOARD OF AGRICULTURE.

PREPARED BY B. H. WALDEN.

1854 Transactions of the Connecticut Agricultural Society, pp. 120.
- Joseph Barratt, M.D. Report on the season of 1846.
  - A few Economic notes on,—
    - *Selandria cerasi* on pear trees.
    - Plant lice on apple trees.
    - Canker worm, absence of.
    - Notes on *Clisiocampa Americana* from 1840-1844.
  - Also gives notes of the dates when he first heard the harvest fly, *Cicada canicularis,* from 1837-1846, page 128. Similar notes regarding Katydid, *Platyphyllum concavum.*

1866 Report of State Board of Agriculture, page 81.
- Mr. Robinson of Hampton. Note on worms on apple trees. "Fire worm," "Canker worm."
- Mr. Barnett of New Haven. Note on treatment of Plum curculio.
- Mr. Leffingwell, West Haven. Note regarding peach borer.
- Mr. David Lyman, Middlefield. Note on canker worm.
- Prof. W. H. Brewer, page 85. Remarks on canker worm.
  - ichneumon fly.
  - Hessian fly.
- Mr. Barnett, page 88. Remarks on thrips on grape vines.
- D. W. Coit, Norwich, page 162. Note regarding thrips on grape vines.
- H. S. Chapman, trouble with rose bugs on grapes, cherries, peaches and apples.
- T. S. Gold, page 202. Notes on Plum curculio, *Rynchœnus nenuphar,* methods of fighting it.
  - *Saperda bivittata.* Notes on life history and remedy.
  - Canker worm, remedy.
  - *Carpocapsa pomonella,* remedy.
  - Peach borer, remedy.
  - Rose bug, remedy.
  - Vine fretter or thrips, remedy.
  - *Selandria cerasi,* remedy.

1869 Prof. A. E. Verrill, page 72. Address, External parasites of domestic animals.
- page 102. Address, Internal parasites of domestic animals.

1871 Prof. S. I. Smith, pages 203-234. Address, Importance of studying insects.
(followed by discussion.)

1872 Prof. S. I. Smith, pp. 345-383. Report of Entomologist to the Board.
Prionus brevicornis, Saperda candidata,
Crioceris asparagi, descriptions and remedies.
Systematic paper on grasshoppers, and a
List of the Orthoptera of Connecticut.

1873 P. M. Augur, page 334. Notes on codling moth, depredations and remedies.
pages 263-268. Discussion regarding the potato bug.

1878 P. M. Augur, page 279. Note on *Saperda bivittata.*

1879 Dr. E. L. Sturtevant, page 132. Address, Some thoughts and facts concerning the food of man.
(insects as food.)

1881 P. M. Augur, page 332. Insect depredations.
A few notes as to remedies for apple borer, canker worm, tent caterpillar and insects that feed upon the foliage.

1882 Alonzo Bradley, page 148. Address, Bee-keeping by amateurs and non-professionals.

1883 P. M. Augur, page 317. A few brief notes on insects.
Discussion on bees: lice, foul brood, Italian queens. Stock in Connecticut.

1884 P. M. Augur, page 290. Note about destroying canker worms.
H. L. Jeffrey, 302. Report for 1884, on Bee-keeping.

1885 Prof. B. F. Koons, page 56. Insects injurious to the apple, 18 pages followed by discussion.
apple maggot.
canker worm.
tent caterpillar.
codling moth.
apple tree borer.
bark lice and plant lice.

1887 Dr. E. H. Jenkins, page 221. Insecticides; Paris green, London purple white arsenic.

1890 Dr. E. H. Jenkins, page 149. Note about spraying to kill the asparagus beetle.

1896 W. E. Britton, page 234. Answering questions regarding asparagus beetle and San José scale.

1898 Geo. T. Powell, page 241. Pear psylla and bud moth discussed in a lecture on fruit culture.

1899 W. E. Britton, 253. Short address on the San José scale, followed by a discussion.

1900	W. E. Britton, page 284.	Talk about San José scale followed by discussion about pea louse by Mr. Britton, Mr. Woodruff, and Gov. Hoard.
1901	S. A. Beach, page 132.	Address, Diseases and Insects injurious to orchard and field crops.
	W. E. Britton, page 193.	Address, Insects and their relation to Agriculture. Illustrated by lantern slides.
1902	W. E. Britton, page 245.	Address, Mosquitoes and malaria.

NOTES.

Mexican Jumping Seeds.—On July 31, some of these curious seeds were received from Mr. F. Chillingworth, a resident of New Haven, who for two years has been connected with a manufacturing business in the City of Mexico. These seeds are also called "jumping beans" and "devil's beans" but they are not real beans as they belong to the plant family *Euphorbiaceæ* instead of to the *Leguminosæ*. Mr. Chillingworth writes that these seeds are considered poisonous by the Mexicans when taken into the human stomach, and this also is mentioned by Dr. C. V. Riley* as being an established fact.

The seeds received were three-celled, and seem to answer the description of the seeds of the species of *Sebastiania,* given in Dr. Riley's article.

It is known that two species of moths infest several species of seeds causing these "jumping seeds." The jumping is caused by the movement of the grub or larva inside the seed, and the movement is induced by the rise in temperature when these seeds are held in the hand.

Carpocapsa salitans Westw. and *Grapholitha sebastianiæ* Riley, are the species recorded from Mexican "jumping seeds."

"Disparene" a remedy for the asparagus beetle.—In the second report of the State Entomologist, 1902, page 172, there is a short account of the common asparagus beetle *Crioceris asparagi* Linn., and hellebore was mentioned as a safe and fairly satisfactory insecticide to use upon the young plants. During the latter part of the season the insects were very abundant,

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* Proc. Entomological Society of Washington, Vol. 2, p. 178.

and severely injured some of the large plants. At this stage, hellebore did not prove sufficiently effective to warrant a continuance of its use. On June 3, the asparagus plants on the Station grounds were all sprayed with "disparene," one and one-fourth pounds in twenty gallons of water. There is very little leaf surface to cover on the asparagus plant, and for that reason sprays have not always been satisfactory when applied to the large plants. "Disparene" contains arsenate of lead as its poison, and this material is noted for its sticking qualities. In this trial the plants were very thoroughly sprayed, the nozzle being directed toward the plants from all sides in succession, and every portion well covered. On June 4, many dead beetles and larvæ were found on and under the plants. Some were alive and feeding. A careful examination was made of the plants on June 9, and only a few living larvæ could be found. Nearly all of the insects had been killed and the plants were far cleaner than they had been since beginning to grow in the spring. The beetles did not again become very abundant on the plants during the summer.

Any preparation of arsenate of lead would probably answer quite as well.

Abundance of Cingilia catenaria Dru.—Caterpillars of this species were received from Terryville on July 12, with the statement that they were devouring the leaves of sweet fern, hazel, apple, oak, chestnut, sumac, huckleberry, and other low-growing shrubs. The caterpillar is a "looper" or "measuring worm," about one and three-fourths inches in length when full grown, and of a yellow color marked with black. There are several indistinct hair lines extending longitudinally along the back and the ventral surface. Each segment is marked on either side with two distinct black spots somewhat triangular in shape, with a small dot between and just below the larger ones, marking the position of the spiracle. The adult is a white moth dotted with black, and is know as the "chain dotted geometer."

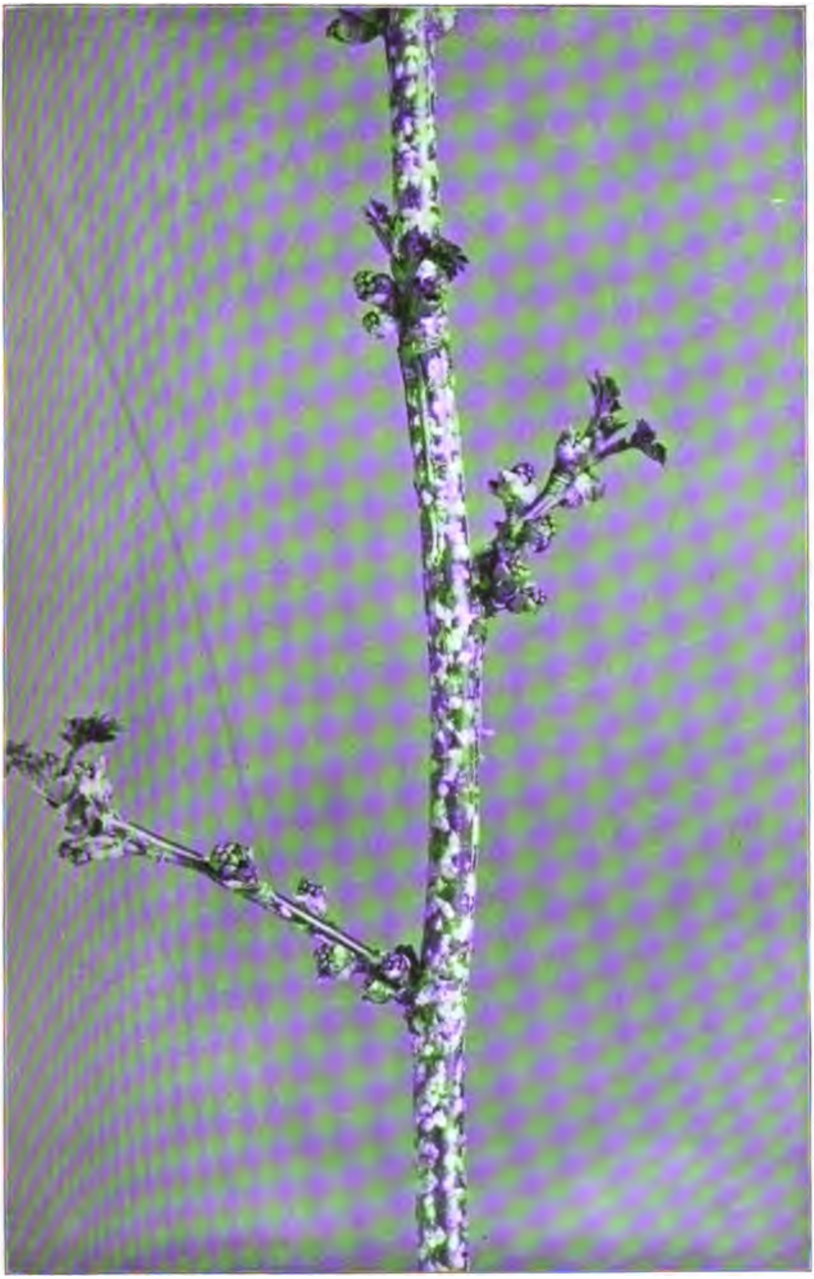
The caterpillars became full-grown about the middle of August and pupated, forming a very beautiful loose net around the chrysalis which was itself beautifully marked. Adult moths appeared a month later.

As the caterpillars usually feed upon wild shrubs, trees, and plants which are not cultivated or prized by farmers, little damage is done by them. Should they attack cultivated crops, however, spraying with arsenical poisons would be the remedy.

Xyleborus celsus Eich.—Mr. C. B. Burrows brought two specimens of this beetle to the Station on September 14. He had taken them from their tunnels in the trunk of a hickory tree in New Haven which had been injured by the hickory bark borer, *Scolytus quadrispinosus*. *X. celsus* belongs also to the *Scolytidæ*, a family including some of the most destructive tree borers.

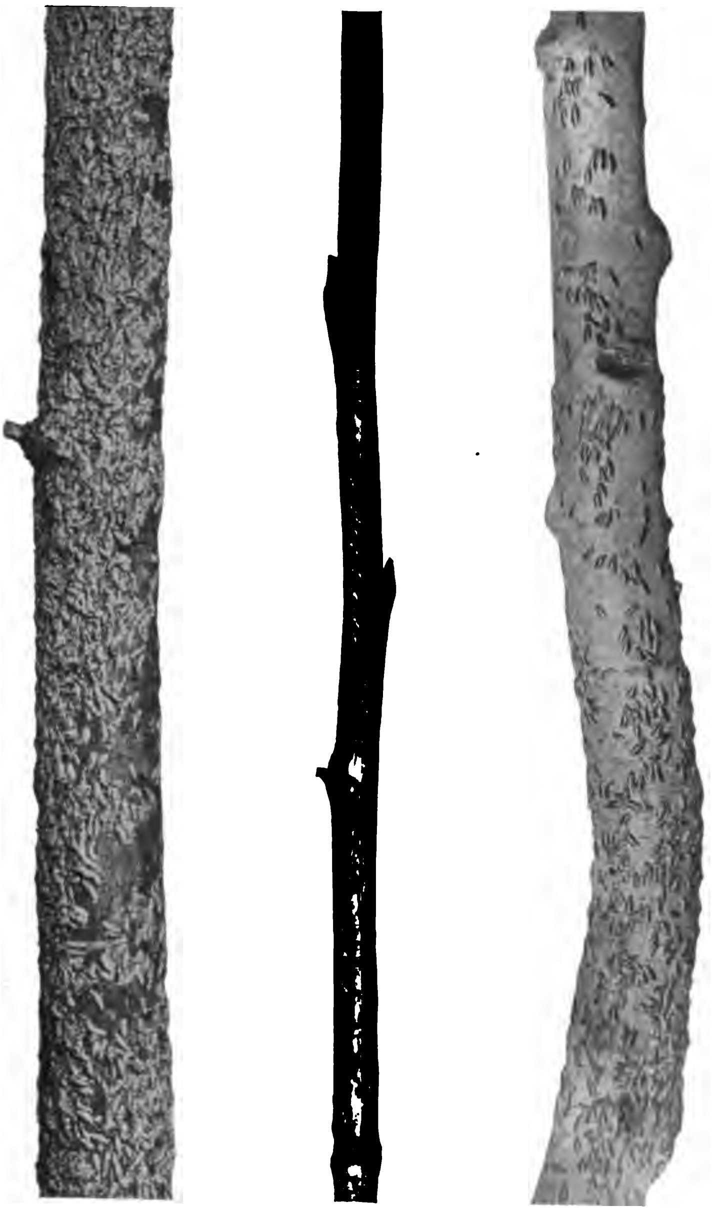
Strawberry leaf-roller attacking dewberries.—On July 1, Mr. Walden visited a field of dewberries in Highwood, where many leaves had been rolled up by some insect. The owner regarded the injury as rather serious and thought that the fruit was considerably smaller on account of the attack of the insect. In a field of several acres many plants each showed as many as a dozen leaves rolled in a characteristic manner. The insect proved to be the strawberry leaf-roller, *Ancylis comptana* Frœl., an insect sometimes causing serious injury to the strawberry. It apparently attacks several allied plants. Spraying with arsenical poisons would, of course, forestall serious injury.

Fumigating to kill San José scale on fruit trees growing under glass.—Fruit trees are sometimes grown under glass in this country in the same manner that they are grown in Europe. In order to save room the trees are usually trained against a brick wall or against the glass into the shape of a fan. In Hartford, peach and nectarine trees trained in this manner became infested with the San José scale. The house was 90 feet long and 11½ feet wide. We were asked to examine the house, and later in December fumigated it with hydrocyanic acid gas. Many of the trees were thoroughly infested and some small branches had been killed, yet the trees were not winter-killed like similarly infested trees out of doors. A subsequent examination showed that the scales were all killed. Reinfestation will doubtless occur again, as the house is open through the summer and there are many infested trees in the vicinity.



SCURFY BARK-LOUSE *Chionaspis furfurus* Fitch.
Females on currant. Natural size.

PLATE II.

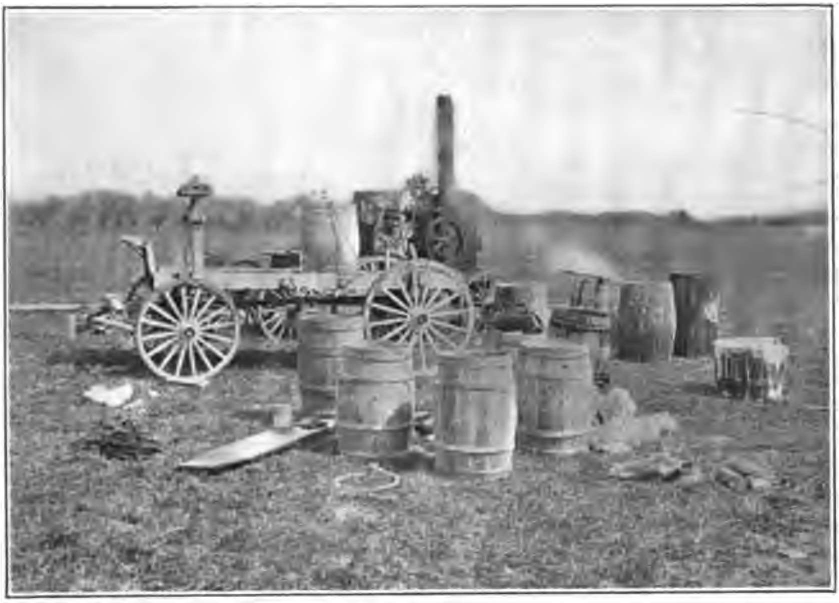


OYSTER-SHELL BARK-LOUSE *Mytilaspis pomorum* Bouché.
Females on poplar. Natural size.

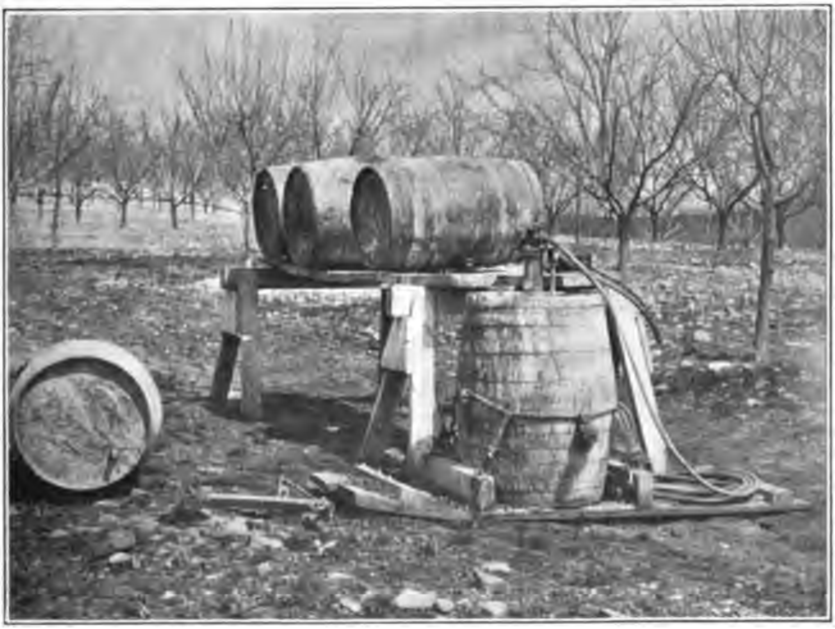
a. Trees cut back ready for spraying. Orchard of Barnes Brothers, Yalesville.

b. View of orchard at Southington. Sprayed trees at the right.

ORCHARD TREATMENT AGAINST SAN JOSÉ SCALE-INSECT.

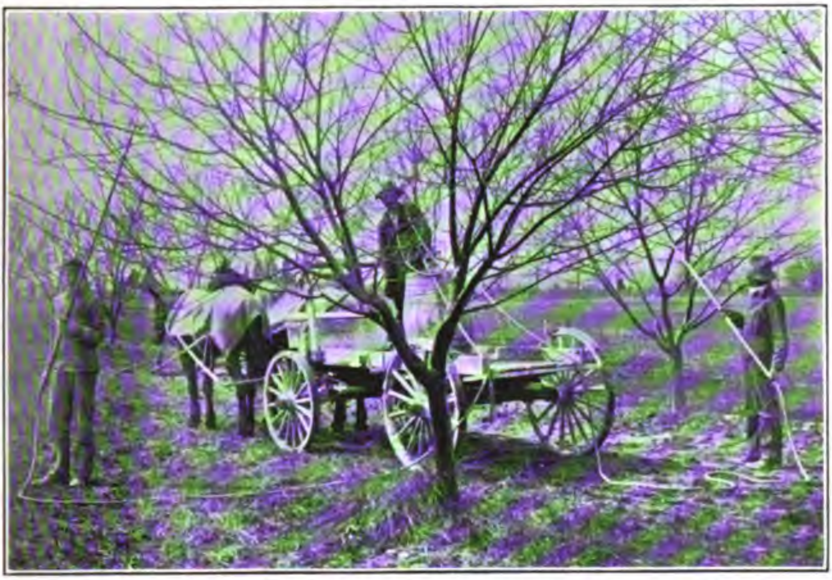


a. Cooking the lime, sulphur and salt mixture at Southington. A Kinney "Safe" engine furnishes steam to boil the mixture in barrels.

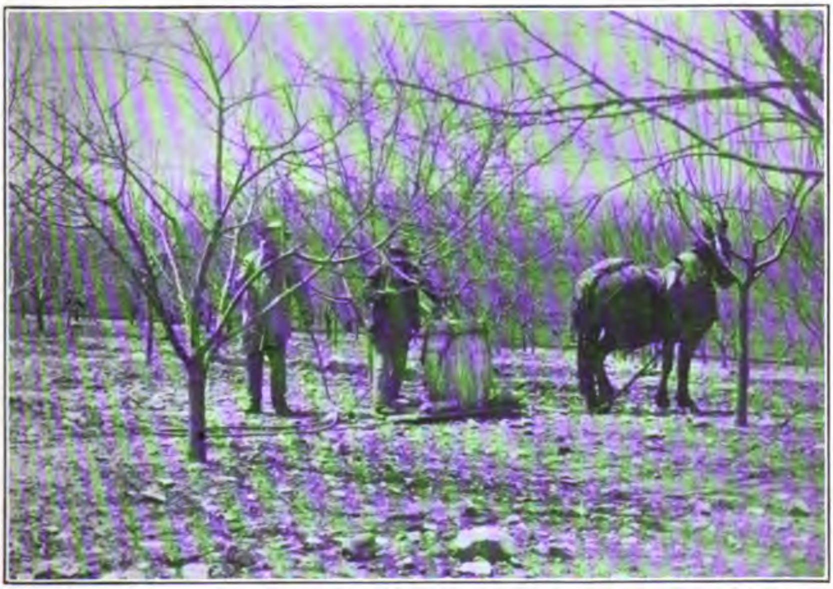


b. View in Barnes Brothers' orchards showing elevated storage barrels and spraying barrel and pump mounted on stone drag.

APPARATUS FOR MAKING AND HANDLING THE SPRAYING MIXTURE.

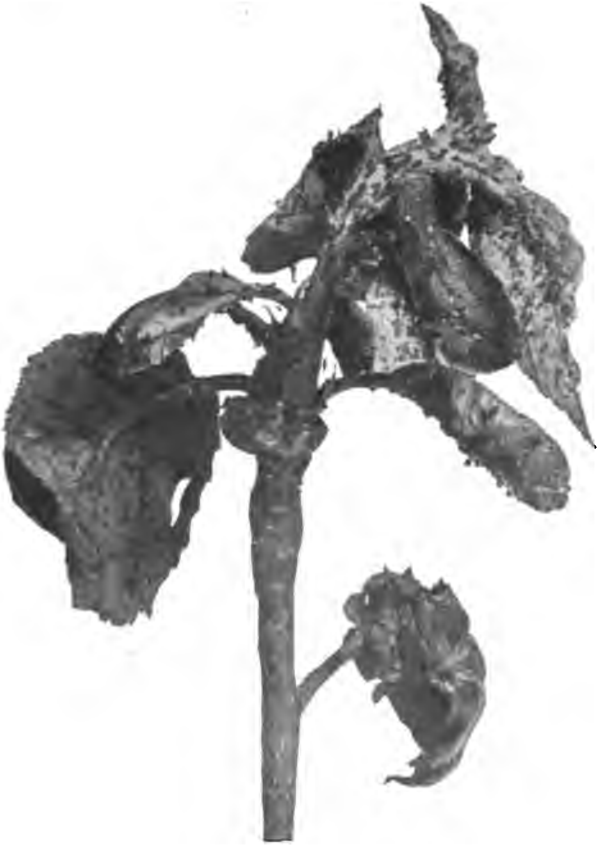


a. Outfit used in Southington Experiments.

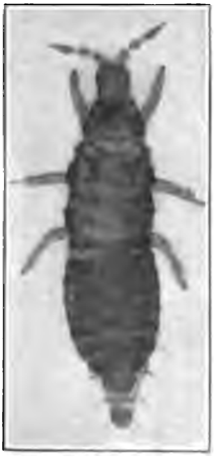


b. Outfit employed by Barnes Brothers at Yalesville.

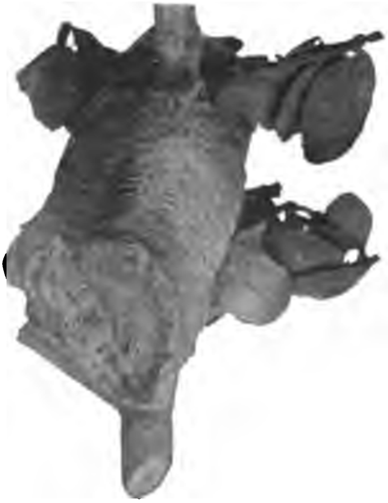
SPRAYING WITH LIME, SULPHUR AND SALT.



a. Apple twig infested with apple aphis, *A. pomi* DeGeer.

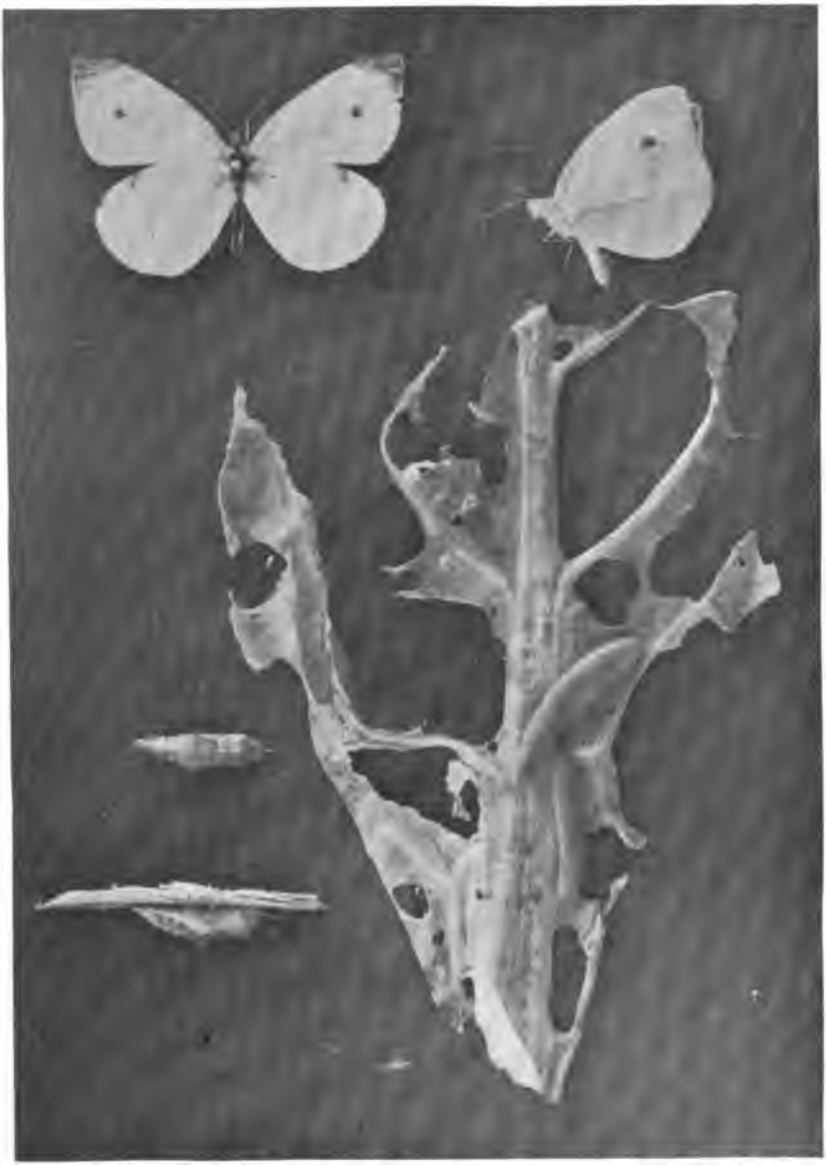


b. The Onion Thrips,
Thrips tabaci Linde.
Immature nymph:
greatly enlarged.



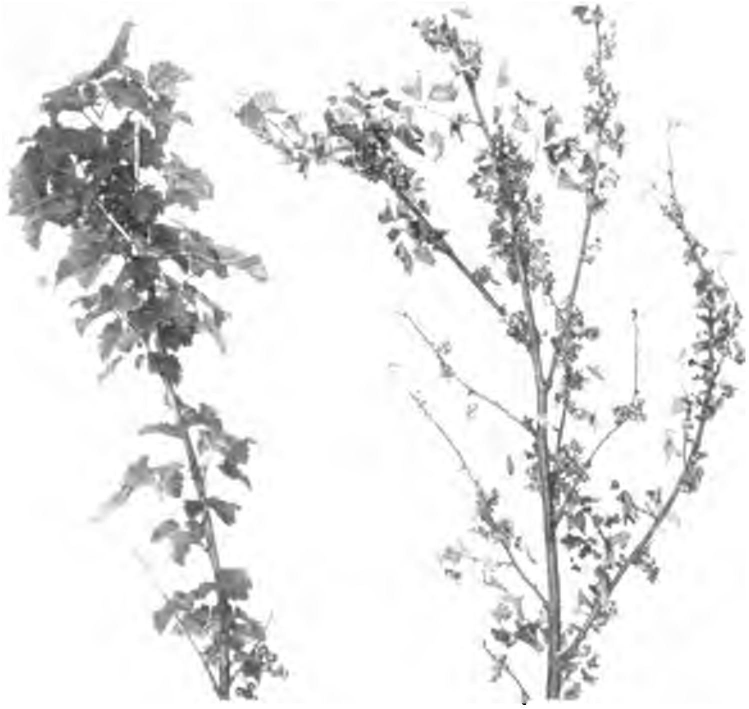
c. Egg-mass of the Chinese mantid
Paratenodera sinensis Saus.
Natural size.

APPLE APHIS, ONION THRIPS, AND EGG-MASS OF CHINESE MANTID.

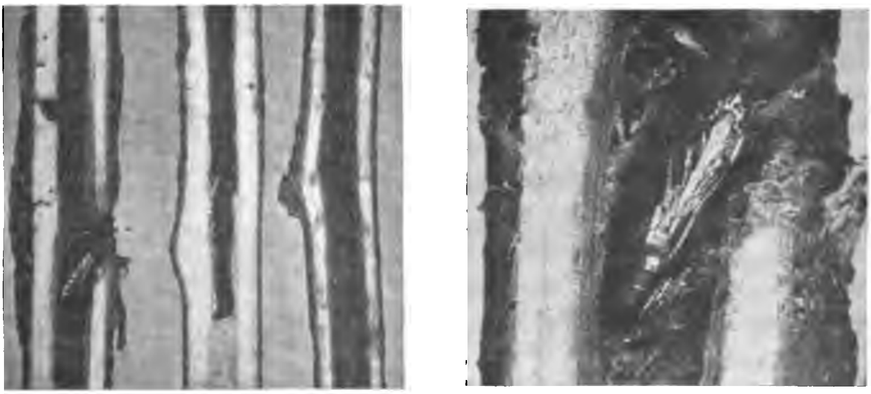


THE IMPORTED CABBAGE WORM *Pontia* (*Pieris*) *rapæ* Linn.
Larva, pupa and adult stages. All natural size.

PLATE VIII.



a. Healthy and infested stalks.



b. Infested stalks split open to show burrows: a pupa and the exit are shown at the left. Natural size.

c. Pupa much enlarged.

NATIVE CURRANT BORER *Psenocerus supernotatus* Say.

REPORT OF THE BOTANIST

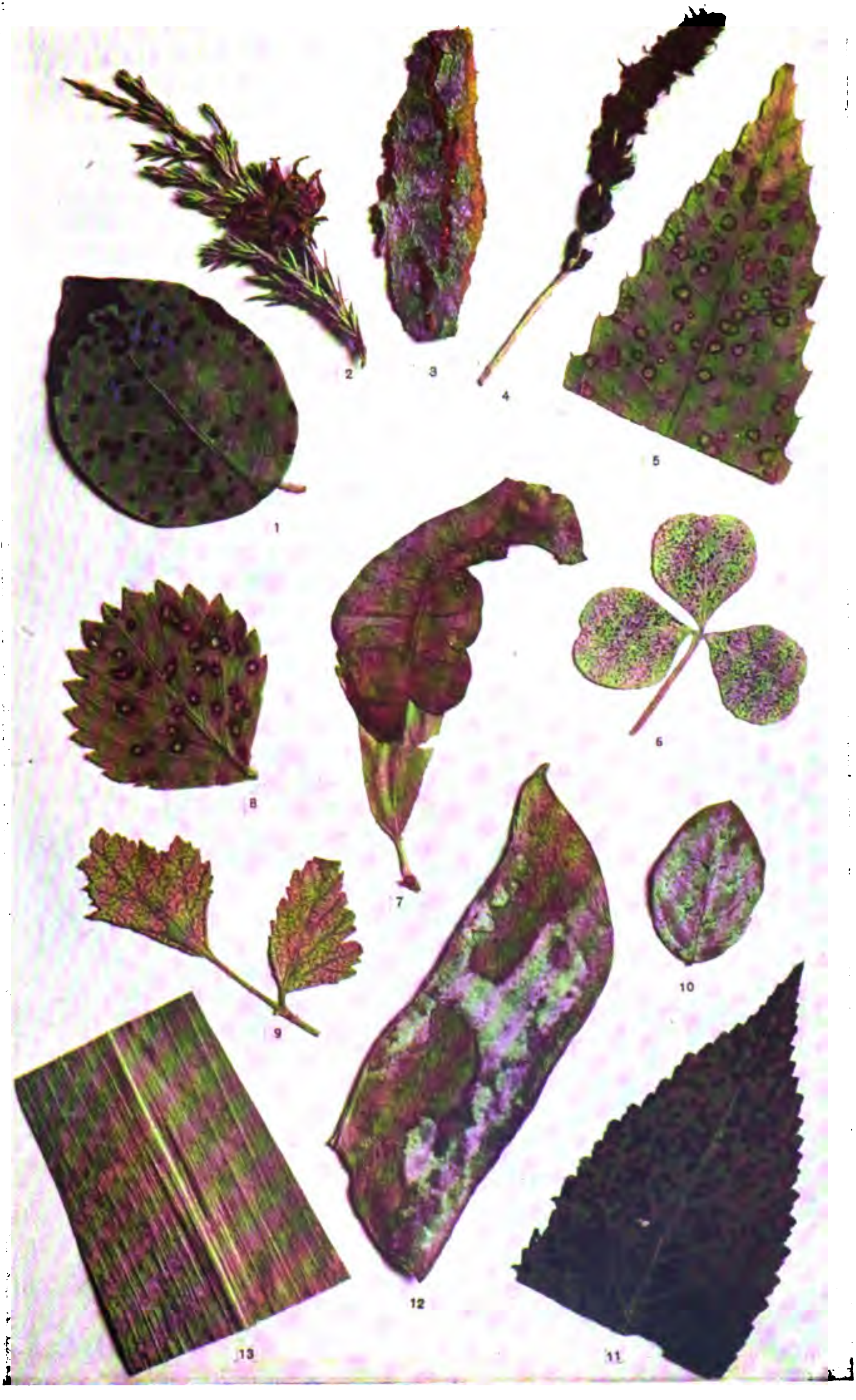
G. P. CLINTON, S.D.

April, 1903

EXPLANATION OF COLORTYPE

Figures about natural size

1. Leaf Blight on Quince; see page 352
2. "Cedar Apple" on Cedar branch; see page 301
3. Red Knot on bark of *Kœlreuteria;* see page 328
4. Loose Smut in spike of Barley; see page 306
5. Anthracnose on leaf of Chestnut; see page 315
6. Black Dot on leaflets of Crimson Clover; see page . . 316
7. Curl on Peach leaf; see page 340
8. Leaf Spot on leaflet of Strawberry; see page . . . 360
9. Orange Rust on leaflets of Blackberry; see page . . . 309
10. Powdery Mildew on leaf of Indian Currant; see page . . 327
11. Leaf Spot as seen on upper surface of Cherry leaf; see page . 314
12. Downy Mildew on Lima Bean Pod; see page 307
13. Leaf Blight on Corn; see page 317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destroy considerable grain and fruit. Mice and rabbits often injure fruit trees by girdling. Sometimes cattle go where not wanted, with destructive results. In towns the injury to our street trees by horses is very evident. See Report 1900, p. 332. Man, himself, is often a mutilator under some conditions when installing city improvements.

2. *Insect Injuries.* These might be classed under animal injuries, but the damage insects cause in the way of chewing, sucking and stinging cultivated plants is so great that they deserve notice by themselves. It is not the purpose to treat of these here since the entomological reports issued from time to time by the Station deal with this subject. Since the fungi are occasionally classified by some persons as "bugs," I wish to call attention to the fact that *insects* as agents of injury to plants are entirely different from *fungi* as disease-producers. Usually the troubles caused by these two agents can be distinguished readily. Holes in the leaves or wood may generally be attributed to insects, dead spots to the fungi. While insects by their stings often cause a morbid growth, they are not true agents of decay as are the fungi and bacteria. The presence of an insect at the place of injury or of the spore stage of a fungus usually indicates the responsible agent.

3. *Physiological Troubles.* These are often obscure as to cause, being due to some disturbance of the natural surroundings of the plants, and are generally progressive in nature. Different conditions produce different troubles and as yet comparatively few have been studied or even noted. *Cold weather* is not an uncommon cause of trouble in plants. Injuries from this source usually result from a mild, late fall (in which the wood of plants fails to ripen thoroughly) followed by a sudden severe freeze, as that of December 9, 1902; or from an unusually severe winter, as has been the present; or from mild, open winter weather, inducing a flow of sap, followed by freezing weather; or from an early spring, inducing premature blossoming, followed by killing frosts, as illustrated somewhat by the spring of 1902. The resulting injuries may be classed partially as mechanical, as the sudden death of the fruit buds, but chiefly as physiological. As yet we do not sufficiently know what troubles result from severe but not fatal injuries to the roots, wood and cambium. The primary effects of the cold

are often manifest at once as a distinct injury, the secondary effects may be obscured in later developments, possibly covering a number of years. The effects of the sudden freeze of December 9, 1902, became evident at once or during the past year by the partial destruction of privet hedges; by the almost total destruction of peach fruit buds, also by the death of some twigs and slight injury to the wood; by the girdled areas in the bark at the base of apple trees; and, in some nurseries, by the severe injury or death of the wood of young fruit trees, especially apples, without apparent injury to the bark or cambium. During the past severe winter, the injury, so far as observed, has been the partial destruction of the peach fruit buds and the very great injury, or even death in some orchards, of the wood, showing by its darkening color down to the snow line. *Heat* by affecting transpiration of moisture may produce wilting of foliage or tip burn; in greenhouses it may even burn spots in the leaves, probably in connection with imperfect glass or drops of water. *Water* when present in excess in the soil shuts out the proper circulation of air and thus causes a sickly yellowish plant growth or drowns it out entirely. In the shape of rain and dew it is the chief factor in the spreading of fungous diseases. *Fertilizers,* when used carelessly, sometimes burn the foliage, injure the roots or often kill the germinating seedlings. On the other hand, the lack of the proper elements of fertility in the soil manifests itself in a scanty or sickly plant growth. *Enzyms,* or chemical ferments, produced in plants through a disturbance of their normal activities and causing a diseased condition of the tissues containing them, are now given as the cause of such obscure troubles as peach yellows, calico tobacco, yellows of asters, etc. Such troubles are sometimes transmitted and are said to be produced by "running out of the stock," by unfavorable mechanical conditions in the soil, etc.

4. *Fungous Diseases.* It is the comparatively few physiological troubles and the very numerous fungous diseases that this article treats. The latter have, as the agents, what are commonly called parasitic fungi. A *fungus* is a *plant* as truly as are the flowering plants, but it is low down in the vegetable kingdom, lower even than is the insect in the animal world. Let us consider more fully the nature of these fungi, their

effect upon vegetation as producers of disease, and the methods employed in combating them. [See Reports 1889, pp. 127-9; 1897, p. 182; 1900, p. 255.]

PARASITIC FUNGI.

Nature of Fungi. As has just been stated, fungi are low in the plant kingdom, in fact, among the lowest and consequently of rather simple structure. Many of them are microscopic in size, while the largest are represented by the shelf fungi, toadstools and puffballs. They differ from the higher groups (the algæ, mosses, ferns and flowering plants) in that they lack *chlorophyll* or the green coloring matter that enables these other plants to manufacture their food directly out of the air, water and soil. They must in consequence, like animals, obtain their food already in an organized state from organic matter. When they obtain this from dead vegetable or animal matter, they are known as *saprophytes,* examples of which are the common household molds, puffballs and toadstools. When they get it from the living plant, or animal occasionally, they produce disease and are called *parasitic fungi,* as the various blights, rusts, smuts, mildews, leaf spots, etc. The line separating parasitic and saprophytic fungi is not very sharply marked, for many parasites have stages that are saprophytic, and some species, ordinarily saprophytes, may under certain conditions act as parasites. In general two structural parts are recognized in fungi; namely, the *mycelium* and the *spores.*

Mycelium. This is the vegetative part of the fungus (corresponding in function, in a general way, to the roots, stems and leaves of the higher plants) since it is largely concerned in gathering food. As stated before, it does not manufacture this food but gets it directly from the *host* (the plant or animal upon which it grows), either from food intended for the latter's use, or as the result of the disorganization of the plant's cells or cell contents by enzyms, or through the formation of morbid plant growths. The disease thus induced may be very local or widespread and it may become evident at once or only after considerable time.

In general the mycelium consists of microscopic threads, becoming more or less branched. The gross aspect is shown by the spawn that ramifies through the soil from the base of the toadstool. These threads are divided more or less by cross partitions into cells which are usually elongated. Generally the threads of the mycelium ramify loosely through the substratum but sometimes they are compacted into masses. The cells when young are filled with protoplasmic and other contents but with age the contents become limited to the walls or to scattered granules. The mycelium is generally colorless. Sometimes it is confined almost entirely to the exterior of the host, only sending short food-gathering branches, *haustoria,* within, as with the powdery mildews; but usually this condition is reversed and the mycelium is entirely concealed within the host, running between or often directly into the plant cells, and becoming evident on the exterior only when specially modified parts give rise to the spore stage. As a rule, then, the mycelium is not very evident or characteristic in the different fungi.

Spores. These are the reproductive bodies and, roughly speaking, correspond in function to the seeds of the flowering plants. They are formed on or from modified threads of the mycelium, usually at or on the surface of the host. While microscopic in size, the spores are usually produced in such abundance as to be evident to the naked eye. Thus in the rusts and smuts the reddish or blackish outbreaks are made up entirely of these bodies. Often they consist of a single cell, varying in shape, size and character of the wall in different species; not infrequently they are composed of two to many cells variously combined, of which, occasionally, only part are fertile. So great are these variations that those of each species usually have some individuality by which they can be recognized and it is chiefly upon these spore differences that the fungi are classified.

Very curiously each fungus generally has more than one kind of spores, sometimes as many as four or five kinds. These spores are of two types, summer and winter spores. The *summer spores* are usually thin-walled, germinate readily and are produced on the external parts of the host in great abundance, to be easily scattered. Their object is to spread the disease to the same or other plants during the growing season. The *winter spores,* on the other hand, are not produced so abundantly, are often buried more securely within the tissues, and if not thick-walled are formed within sacs and receptacles that protect them to a great degree from moisture and cold. Frequently they will not germinate until the following spring. Their evident function is to carry the fungus over the unfavorable period of winter weather. Mycelium in the perennial parts of the plant, also, may serve this same purpose, as in the case of the orange rust of blackberry.

The different kinds of spores are produced at different times of the year, usually the summer spores in spring and summer and the winter spores in summer and fall. Thus, the red (summer) stage of rusts precedes the black (winter) stage. This peculiarity is carried a step further when we find one spore stage developing parasitically and another saprophytically. Thus, in apple scab the summer spore stage exists as the "scab" of the living leaves and fruit while the winter stage develops on the dead leaves in the fall and following spring. The separation of the spore stages, however, becomes widest when they occur on entirely different host plants, one producing the other. Such is the case of the cedar-apple rusts and the barberry-wheat rust.

To solve the complete life history of a fungus, therefore, often becomes a considerable problem. It is because of these complications that botanists have often described different stages of the same fungus as distinct species. There are many parasitic fungi of which only the summer spore stages are known but which are suspected of having saprophytic winter spore stages, since detailed study of related forms has often brought these to light.

Fungi infect their host through the germination of the spores. Moisture in the shape of rain or dew is necessary to induce this. Usually the germination must take place on certain parts of the plant in order to secure entrance. Often the parts permitting infection are quite localized but more often it is a question of the tissues being in a young state and thus easy of penetration. The common method of infection is for the spore to send out a short germ thread which enters the plant through the *stomates* (breathing spores) or else bores directly through the tissues. Once inside, this thread, by growth, gives rise to the extended mycelium. Comparatively few spores meet conditions that insure infection of the host, hence the necessity to the fungus of great numbers of spores.

Relation to weather. We have remarked on the importance of moisture to germination of spores and consequent infection of hosts. The character of the weather thus bears important relation to the spread of plant diseases, especially with certain kinds at special times. It is not the amount of rain that falls that is most important but the time it takes. For example, a few days of moist weather with comparatively little rain but also with little sunshine to dry away the moisture from the foliage is evidently more favorable for spreading these troubles than a violent rain storm followed the same day by bright sunshine. Cloudy weather, by hindering evaporation of the water transpired by the leaves, may aid in the spread of disease.

In its relation to different diseases of plants, the season of the moist weather is very important. For instance, a rainy April-May period is very favorable for apple rust; a cold, moist May or June aids decidedly the introduction and spread of apple or pear scab. The fruit grower dreads moist weather during the ripening and harvesting period of his peach and plum crop, since brown rot flourishes chiefly at this time. The market gardener is specially anxious about the rainy week that may come in July or August and blight his potato vines, and which, if followed with additional rainy weather, is likely to rot the tubers; or of wet August and September weather that produces stem rot in his onions. The downy mildews are especially lovers of moisture, and so the musk melons and cucumbers have suffered from one of these troubles during the past three years, because of their moist summers.

Water affects the spread of fungous diseases in three ways: First, many fungi, especially the stages producing thin-walled, ephemeral spores, produce these only or most vigorously during moist weather. Second, the rain, in a measure, acts as a distributing agent, washing the spores over different parts of the plant. Third, water, as has been stated before, is needed for the germination of the spores.

Injury and Loss. It is evident from what has been written that parasitic fungi often become agents of serious disease in plants and thus cause greater or less financial loss to the husbandman. It is not the intention to present an array of figures showing the losses caused by these parasites in Connecticut, for startling as these might look, they are not nearly so suggestive to the grower as some personal recollection he may have of local losses. Occasionally one hears the remark, "Fungous troubles are much worse than formerly. We never used to be bothered so by them." Very often this statement is incited by a season that has been especially favorable for such troubles, or is drawn forth by an unusual personal loss. Where plant growing is intensified, as it is in Connecticut, we may reasonably expect more trouble from fungous pests than occurred in the earlier days when farms were more scattered, importations limited and crops less specialized. We should bear in mind, however, that agitation and information now make losses seem more prominent than formerly, since then the grower knew less of the why and wherefore of his troubles, attributing them, perhaps, wholly to season and luck.

Some of the pests causing serious loss during recent years may be briefly mentioned. *Brown rot* of peaches and plums is always present at harvest time, some seasons becoming so prevalent that it sweeps away a large part of the profits in a few days. The past year produced a small peach crop and this accounts in part for the small amount of rot, even in early varieties, as the fruit of heavily laden trees always rots more or less because of the facility for spreading the disease. *Scab* or black spot is another trouble of the peach that attracts the attention of the grower, for, while it is not primarily an agent of decay, it causes the fruit to become second class in appearance, often smaller in size or one-sided, and by cracking it, opens the way for decay. This trouble seemed to be worse than usual the past season. *Black knot* of plums and cherries is an old trouble that proved more prominent than usual last year. This is one of the few fungous diseases against which laws have been directed in some states. *Downey mildew* or *blight* of potatoes during the past two years has prematurely killed the vines in July or August, thus cutting down the crops of the late varieties 25 to 50 per cent., for the vines should have lived until killed by the September frosts. During the past season rot of the tubers, following the blight, added to the loss and attracted considerable attention among the growers. *Stem rot* of the White Globe onions has now been very bad for two years and has almost discouraged the growing of this popular and otherwise very profitable variety. In the vicinity of Green's Farms and Southport in 1902, the loss was reported to be in the vicinity of $50,000, and last year some growers, after marketing part of the crop with returns little greater than the freight charges, threw away the remainder. The *Downy Mildew* and other troubles of the musk melon have proved so serious during recent years that many have given up growing this plant. The greenhouse man has his special troubles with the leaf spot of violets, rusts of carnation and chrysanthemum, mildew and leaf spot of rose and the various stem rots, and sometimes the local loss caused by one or more of these fungi becomes considerable.

Classification. Botanists have classified the fungi under various groups according to their relationships. Some of these groups contain only forms that are of little economic importance, but the chief divisions all contain at least some important parasitic forms. The scientific name of a plant conveys some idea of its nature and relationships. Dr. Sturgis in his Literature of Fungus Diseases [see Reports 1893, p. 253; 1900, 255] aimed to apply the common names somewhat similarly, so that the terms rust, smut, blight are applied only to certain related forms and not used indiscriminately. Since in the following notes this plan has been largely followed, it may be profitable to discuss briefly a popular classification of these chief groups:

Slime Molds. Some scientists place these forms with the animals, and strictly considered they are related to rather than a group of true fungi. Ordinarily they occur as saprophytes that are found chiefly on decaying stumps in the woods during moist weather. At first they consist of brightly colored naked masses of protoplasm that ooze out in jelly-like masses on the wood, but in a dry atmosphere these soon change into clustered spore-bearing bodies. They are mentioned here because at least two forms are parasitic; viz., club-root of cruciferous plants and crown-gall of fruit trees. In both of these diseases there is a morbid growth of the infected tissues of the host but there is no evidence to the naked eye of the causal agent. See Plates XV, a; XXIV, b.

Bacteria. These, also, are hardly true fungi but are very closely related to the lowest forms and for all practical purposes may be considered with them here. Bacteria as agents of contagious diseases in animals, especially in man, are recognized as very important organisms. While the diseases produced in plants are comparatively few, these are usually of importance and are very properly designated *blights*. They cause the death of the tissues invaded and these often assume a semi-water-soaked appearance. No sign of the bacteria is seen save occasionally in the sticky slime that oozes out on the surface. Examining this under the microscope, we see myriads of these smallest and simplest of living organisms—mere rounded or elongated cells too small to be seen save with the highest powers. Insects are very important factors in the distribution of these germs and they are among the most difficult troubles to control. Prominent examples are pear blight, bean leaf blight [Plate XIII, d], blight or wilt of cucurbits [Plate XXVI, a] and wet rot of potatoes [Plate XXII, a]. Some bacteria are useful, as soil bacteria, those producing root tubercles on leguminous plants, those giving flavor and aroma to butter, etc.

Thread Fungi (including *Downy Mildews*). This group includes a miscellaneous lot of fungi of which only the *Downy Mildews* are of economic importance in this state. These mildews are usually distinguished by the rather dense whitish growth they form on the outside of the infected parts. See Plate XIII, b. Examining this under the microscope, it is found to consist of erect fertile threads having a special, often tree-like, branching above, on the tips of which the thin-walled summer spores are borne singly. Less commonly, these fungi form large, thick-walled, dark colored winter spores embedded in the tissues, from which they are liberated only by decay. Prominent examples of the downy mildews are blight of potatoes [Plate XXIII, a], downy mildew, or blight of melons and cucumbers [Plate XVIII, b], and the downy mildews of lima beans [Plate XIII, b], and of grapes [XVII, b].

Smuts. The smuts cause very important diseases of the cereals, especially in the central and northwestern part of this country. As their name indicates, they are ordinarily distinguished by the "smutty" outbreaks on various parts of the host, most commonly occurring in the floral parts. Some species, the white smuts, of which few are of economic importance, are permanently embedded in the tissues and lack this dusty character. These outbreaks are made up entirely of the spores. The spores are usually single cells, but may consist of several cells united into a ball, which sometimes is covered with a coating of sterile cells. The spores in germinating often give rise to secondary spores, after the fashion and nature of the yeast fungus, and these help greatly in spreading the fungus. In the case of corn smut, for instance, these secondary spores are capable of existing and multiplying sapropyhytically in manure. In this state, the most injurious smuts are those of onion, corn [Plate XVI, b], oats [XIX, e] and barley [XIII, a].

Rusts. Rust is a term often used by growers to indicate any spotting of foliage, but as restricted here, it is applied to those small, reddish or blackish outbreaks on leaves and stems that are somewhat similar to the smuts but usually less dusty and often quite firm. They form a very common and large group, and include some of the most injurious of our parasites. In this state, the economic species include such examples as apple rust [Plate XI, c], oat rusts [Plate XIX, c-d], carnation [Plate XV, b] hollyhock [XVII, d], bean [Plate XIII, e] rusts, etc. The rusts are especially interesting because their spore forms may occur on different hosts. Let us illustrate this with the case of the black stem rust of oats: *spermatia,* inconspicuous, supposed spore stage, on upper surface of barberry leaves; I, *aecidio-spores* borne on the under surface, beneath the above, in the cluster cups; II, or *uredo-spores,* forming the reddish outbreaks on the stems of oats in early summer;. III, or *teleuto-spores,* forming the black, less dusty, outbreaks on these same stems later in the season. Some rusts possess only one or two of these stages. In the case of the apple-leaf rust, the aecidial or summer spores occur on the apple leaves and the teleutal or winter spores on the cedar in the "cedar apples."

Fleshy Fungi. These are the most conspicuous fungi, including the toadstools, shelf fungi, puffballs, etc. The "spawn" of the cultivated toadstool is the mycelium, and it is perhaps chiefly by this that these fungi are carried over the winter. The toadstool itself is the fruiting body, bearing the thin-walled spores on the surface of the *gills,* that radiate out on the under side of the *cap.* In the puffballs, the dusty cloud that puffs out on pressure is composed of the spores. These forms are largely saprophytic, getting their food from the humus of the soil or dead wood. Some species are parasitic on trees; the injury done to trees and timber by the mycelium, causing dry rot, is very considerable.

Sac Fungi (including *Powdery Mildews*). Under this group come a great variety of fungi, including some of our most destructive parasites. They are distinguished microscopically by the fact that their winter spores, often eight in number, are borne inside of sacs or *asci*, and these in turn are enveloped, partially or wholly, by a special receptacle. The powdery mildews constitute one of the most distinct and important groups of this class. They are characterized by their mycelium developing on the exterior of the host, showing as a cobweb-like or cottony growth. The summer spores are produced on this in upright chains. The winter spores, asco-spores, are formed inside the small yellowish or blackish balls, *perithecia,* that can be seen with a lens, or often by the naked eye, embedded in the mycelium. See Plate XV, c. The great variation in the character of the sac fungi is shown by the following examples: powdery mildews of cherry [Plate XV, c], phlox [Plate XXIV, a], and rose [Plate XXV, a]; black knot [Plate XXIV, c], black rot [Plate XVII, a], ergot [Plate XXV, b]. Not uncommonly the summer spore stages of this class of fungi are serious parasites, while the winter spore stages develop merely as saprophytes, as in the case of apple scab, bitter rot and brown rot.

Imperfect Fungi. These are so-called because only summer spore stages are known. They are suspected, for the most part, to be merely stages of the sac fungi, and every once in a while these winter stages are found, as recently in the case of bitter rot of apples and brown rot of peaches. Under this group come many of the leaf blights, leaf spots, anthracnoses, molds, etc. Common examples are sooty blotch of apple [Plate XI, b], black rot of quince, anthracnose of bean [Plate XIII, c], potato scab [Plate XXII, c], leaf spot of violet [Plate XXVIII, d], etc.

PREVENTION.

It has become evident to the reader who has followed us thus far, that the fungous troubles of Connecticut are of sufficient importance to demand the efforts of the grower to lessen their ravages. What are some of the methods that may be employed to control them?

Selection. The first requisite for good plants is *Good seed,* spelled with a capital *G*. Aside from any physiological advantage that large, plump, thoroughly matured seeds may have over smaller shrivelled ones, the former are less likely to come from diseased plants or to carry disease germs than are the latter. In some cases it is desirable to know the origin of the seed, for in the case of the grain smuts, the spores adhere mechanically to the seed. Evidently, seed from a field free from smut is to be preferred to that from a very smutty field, though the seed may look as good. Potato tubers, though not strictly seed, come under this class. Use scabby tubers and the resulting crop will be more or less scabby, according to the season. The same principle holds true of *nursery stock.* Buy of the most reliable firms, avoid purchase from nurseries where certain troubles are known to be bad; inspect the stock when it comes and discard the poor, especially if it shows knots or diseased areas. *Selection of varieties* may aid in some cases to keep down specific troubles, since it is well known that varieties vary in susceptibility to disease. For example, in a recent visit to a nursery, the writer saw Wealthy and Fallowater apples abundantly covered with leaf rust, while all of the other varieties in the same block of trees were free. Greenhouse growers well know that there is wide difference among the carnations in rusting. Our government botanists have even taken up the task of rearing *disease proof* varieties to certain diseases *by selection and breeding.* Along this line, the writer recalls what was told him by an eastern asparagus grower who was troubled with rust. He said he noticed in a certain spot of a neighbor's field that a few asparagus plants always remained green after the others were dying from the rust. He obtained plants from that place, and was gradually building up a bed to determine if he could secure exemption from the disease by obtaining a rust-proof variety. He may or may not succeed, but his experiment costs him little to determine this point. *Selection of ground* certainly counts in those cases where disease has become established in the soil. A rational system of rotation must be adopted to prevent or lessen such troubles as onion smut, potato scab, club root, etc. Through continued use, especially with the same crop, the soil of the greenhouse may become infected with stem rot, drop and other fungous troubles.

Cleanliness. It is easier to write about ideal farm methods than it is to carry them out; nevertheless, no one will deny that cleanly methods are the best. *Thorough culture* not only destroys weeds, conserves moisture, but it aids in the quicker destruction of old leaves, etc., that may be harboring the disease germs of last year's crop. *Refuse* of the present crop, especially when diseased, if left on the land, becomes a menace to succeeding crops of a similar nature. When one sees a turnip field in which the owner has very carefully gathered all of the roots except those "clubbed," he feels confident that the grower is helping along the trouble in the future use of that field for a similar crop. So, too, a field left covered with anthracnosed melons does not help the success of future crops. The *manure pile* is a very essential feature to successful plant growing, but it *should not be made a refuse pile* upon which diseased vegetable matter is dumped. It will never do any harm to gather carefully all rotting fruit and refuse stems from the garden or orchard at the close of the season; it will do good, but the place to put them is in the bonfire.

Pruning. With certain diseases, the best treatment consists in the removal of the affected parts. In *pruning* pear trees for blight, or plums for black knot, one must cut off the infected branches so as to include *all of the diseased wood.* Aside from the removal of the diseased limbs, pruning is useful by letting in air and sunlight to aid in the rapid evaporation of moisture and thus hinder infection from germinating spores; it also lessens the work of spraying, where this is done. The *thinning of fruit,* when abundant, or the removal of decayed specimens, is a common practice that aids in minimizing most rot troubles. Greenhouse men fight many troubles, as leaf spot of violet, by picking off the diseased leaves as fast as they appear. As many of our greenhouse and garden troubles first get a foothold on a few leaves, the prompt removal of these is desirable. The place for all such refuse is the fire.

Fungicides. One of the most effective methods of fighting many fungous diseases is by the use of fungicides. These are prepared in such strengths that the spores adhering to the treated parts are either killed or prevented from germinating while the tissues of the plant are not injured. Such treatments are made in different ways to meet the requirements of various troubles. *Seed treatment,* for instance, where the seed is soaked or sprinkled with the mixture, has been found an effective method for preventing most of the cereal smuts. Applied to the tubers it is one of the ways of keeping down scab of potatoes. *Soil treatment* is sometimes given where the germs become established in the ground, as in the case of onion smut and club root, when lime and sulphur may be used.

Fungicides are most commonly applied as a *spray.* By means of spray pumps, the fungicide is distributed uniformly *over all parts liable to infection* as a fine mist. Upon drying, if the fungicide contains a sediment, this serves to destroy spores that are brought later. Spraying depends largely for its success on preventing rather than curing disease. The man who wins with this treatment is the one who anticipates and precedes his trouble rather than the one who follows along after the disease has gained a foothold. From the above consideration, it becomes apparent that there are two very important factors to successful spraying; namely, it must be done always with *thoroughness* and at the *proper time,* which varies with the disease to be treated. A great many substances have been tried as fungicides; a few of the most valuable are given here. Further information on this subject is given in Reports 1890, p. 110; 1893, p. 103; 1898, p. 266, and Bulletins 111, 115, 125, 142 of this Station.

BORDEAUX MIXTURE. *4 lbs. Copper Sulphate, 4 lbs. Fresh Lime, 40 to 50 gals. Water.* Dissolve the copper sulphate in hot or cold water, suspending in a coarse bag. Slake the lime in a small amount of water and then strain into the spray barrel which is half filled with water. Dilute the copper sulphate to about half a barrel and then pour into the spray barrel, stirring the mixture. If necessary, add a little water to fill the barrel. Where large quantities are used, it is advisable to make stock solutions of the lime and the copper sulphate, each containing 1 lb. to 1 gal. of water. The proper proportions of each (4 gallons each per barrel) can then be used, as in the preceding account, when needed. Bordeaux mixture is the best fungicide and is to be used in all cases except when sediment on the sprayed parts is objectionable. The home-made mixture is preferable to anything bought in the market; and the dry powders used for dusting merit little attention as yet.

DILUTE BORDEAUX. *2 lbs. Copper Sulphate, 4 lbs. Fresh Lime, 40 to 50 gals. Water.* This is sometimes used when there is danger of burning the foliage by use of the stronger solution, as in the case of peach and Japanese plums. Caution, however, may be necessary even with this strength, especially on old foliage. Perhaps it is most useful for the second spraying, when necessary for peach curl.

RESIN BORDEAUX. *5 lbs. Resin, 1 lb. Soda lye, 1 pt. Fish Oil, 5 gals. Water.* Dissolve the resin in the oil heated over fire; cool and add the lye, stirring slowly; then add water and boil until mixture will dissolve thoroughly in cold water. Use at rate of two gallons to a barrel of Bordeaux. This makes the Bordeaux mixture adhere better to smooth foliage and also to last longer. It will probably be found most efficient when used on such plants as carnations, onions, asparagus, etc.

SODA BORDEAUX. *1 lb. Soda lye, 3 lbs. Copper Sulphate, 5 oz. Lime, 30 gals. water.* Halsted, of New Jersey, gives this as a substitute for Bordeaux when one objects to much sediment. It requires more care in its preparation, as an excess of soda, or too little, will burn the foliage, so the formula calls for just enough soda to neutralize the copper, with a little lime added to make it slightly alkaline. Selby, of Ohio, used a slightly modified formula (4 lbs. copper sulphate, 1⅛ to 1½ lbs. soda lye, 50 gals. water), which he preferred to Amm. Sol. Cop. Car. for the late sprayings against black rot of grapes. His formula, because of the omission of lime, leaves no sediment.

AMM. SOL. COP. CARBONATE. *5 ozs. Copper Carbonate, 3 pts. Ammonia, 45 gals. Water.* Dilute the ammonia, if strong, with several volumes of water and use just enough to dissolve the copper carbonate; then dilute with water to 45 gallons. This fungicide is often used to replace Bordeaux when no sediment is desired on the sprayed plants. Because it lacks this sediment its fungicidal value is temporary and it has to be used more frequently. There is danger of burning the foliage if the solution is improperly prepared, so care is needed to use just enough but not too much of the ammonia. It is most frequently used in the later sprayings for bitter rot of apple, rots of grapes and celery leaf spots.

COPPER SULPHATE. *3 to 4 lbs. Copper Sulphate, 45 gals. Water.* This strength is used as a winter spray, where it is desired to kill spores (or lichens) on the limbs. A weaker solution, *1 lb. to 250 gals.*, is sometimes advocated as a summer spray for peach rot; but the writer has not tried this strength.

POTASSIUM SULPHIDE. *3 ozs. Potassium Sulphide, 10 gals. Water.* This fungicide has been found especially useful on the powdery mildews. Because it leaves no sediment, it is also adapted for greenhouse work in general but requires frequent applications. A different strength has been used for sprinkling grain to prevent smut.

FORMALIN. *(A) 1 lb. (1 pt.) Formalin, 50 gals. Water. (B.) 1 lb. to 30 gals. Water.* The (*A*) formula is used for prevention of grain smuts, by thoroughly sprinkling a pile of the grain which is stirred so that all the seeds are wetted. The grain is left in piles or sacks over night before drying or planting. The (*B.*) formula is used for potato scab, the tubers being soaked in it 1½ to 2 hours. Selby, of Ohio, also recommends its use for onion smut, the seed being sprinkled as it lies in the drills at planting.

CORROSIVE SUBLIMATE. This is sometimes used instead of formalin for grain smuts or potato scab. In the latter case the tubers are soaked in a solution 1 lb. to 50 gals. for 1½ hours. This is a *poison* and corrodes metals, hence care is needed in its use.

SULPHUR. In the greenhouse this is used to check the powdery mildews. Most frequently the powder is sprinkled over the foliage. Sometimes the fumes produced by heating are used, but care should be exercised not to ignite the sulphur. A better method is to mix the sulphur with oil and paint this on the steam pipes. Sulphur is also used, sometimes with lime, on infected land to prevent onion smut. Stewart, of New York, recommends 100 lbs. mixed with 50 lbs. air-slaked lime per acre, used in the drills with the seed.

LIME. Occasionally this is put on land infested with certain fungi. For club root of cabbages, etc., 80 bushels per acre sown broadcast in the fall is recommended. For onion smut 75 to 125 bushels per acre drilled in with a fertilizer drill are required.

HOT WATER. For the grain smuts, soaking the seed 10 to 15 minutes in hot water at 132-5° F. is one of the most effective preventive treatments. Where large amounts of grain are to be treated, the cumbersomeness of the method and the trouble in drying the grain are the chief objections against its use.

SPRAY MACHINERY.

For a general discussion of this subject and illustrations of types of pumps, see Bulletin 125 of this Station, also Reports, 1890, p. 104; 1893, pp. 74, 105; 1898, p. 266. It is purposed here merely to mention the different kinds and indicate the field in which they are most useful.

Atomizers. These are bellows that produce the spray from a small cup containing the liquid at their tip. They are hard to work for any length of time and their usefulness is confined to the greenhouse or small beds of ornamental plants outdoors.

Powder Guns. These are used to dust dry mixtures over the surface of plants, usually when dew is on them. They are not of much value in fighting fungi.

Pail Pumps. The best form is that in which the pump is inserted in any pail and held in place by the foot while one hand is used to pump and the other to direct the spray. These are of value around gardens or with small fruit grown on a limited scale. Effective pumps are likely to be expensive.

Knapsack Sprayers. There are two types; those in which compressed air is first pumped into a reservoir and then used at will to force out the spray, and the common type in which the spray is forced out directly by pumping. These are useful on small fruit farms or in gardens where one can not use a barrel pump mounted in a wagon. It is rather hard work to carry one of these pumps on the back and spray for any length of time and so they are not very popular.

Barrel Pumps. When one wishes to get among plants where there is not room for a wagon, the small barrel pump mounted on two wheels is very handy and preferable to the knapsack sprayers. The ordinary pump mounted in a kerosene barrel and carried around in a cart or light wagon is the type in most common use. The style in which the air chamber is immersed in the barrel with only the handle protruding is now accepted as the best. In purchasing such a pump, one should select a durable rather than a cheap make, and one that is strong enough to readily supply two lines of hose, each with a double nozzle. In commercial orchards force pumps are sometimes used in tanks of large capacity. For certain purposes, as potato spraying, an apparatus may be fitted up with stationary nozzles. See Report 1893, p. 75.

Power Sprayers. In these machines the power is other than by hand. Steam is used in some cases, but such machines have scarcely obtained a foothold in this state. The most common type is where the power is supplied by the horses through gearing. This makes it necessary to keep the apparatus moving, and thus often prevents sufficient spray reaching the plants. Recently, machines in which the force is supplied by compressed air or by liquid carbonic acid gas have been placed on the market and are attracting attention. As yet, a perfect and cheap power sprayer does not seem to have been developed.

NOTES ON SPECIFIC TROUBLES.

The following notes are upon the specific troubles that have been reported in this state. Most of them have been seen the past two seasons. A few of the hosts, though economic, are not grown commercially in this state. Some of the fungi, while occurring on cultivated plants, are scarcely of economic importance. One can never be sure, however, that these may not at some time become troublesome. The few physiological troubles that are given are distinguished in the headings by the use of italicized common names. Specimens of all have been placed in the Station's herbarium and special mounts of the most important have been made for educational purposes. The hosts are arranged alphabetically.

ALFALFA, *Medicago sativa.*

LEAF SPOT, *Pseudopeziza Medicaginis* (Lib.) Sacc. This is a common fungous trouble of alfalfa, though not so important in this state since the host, apparently, can not be extensively grown here. It shows as small reddish purple spots scattered over the leaves, which finally become yellowish. The only time the fungus has been reported as injurious was by Sturgis in the Report for 1899, p. 281.

APPLE, *Pirus Malus.*

BITTER ROT, *Glomerella rufomaculans* (Berk.) Sp. & von Schr. Plate XII, c. The summer spore stage (*Glœosporium fructigenum*) of this fungus is responsible for serious injury to apples, especially during recent years in the middle west. In Connecticut it does not seem to be nearly so troublesome. The fruit often begins to rot, while yet green, early in July, and if the season is moist from then on the trouble becomes greatly increased, even causing serious rotting after the apples are stored. Rotten sunken areas are formed which rapidly increase in size, and in moist weather produce numerous pinkish fruiting pustules arranged in concentric circles. The spores are viscid and so are easily carried by insects. Recently the fungus has been discovered on the branches, where it forms cankered areas often at the base of the old fruit spurs. It is in these that the mycelium passes the winter and produces spores for general infection another year. The winter or asco-spore stage is saprophytic and curiously enough was observed in artificial cultures of the fungus before found in nature. Besides the apple, this fungus has the pear, and probably the quince, for hosts in this state. The treatment given for apple scab, coupled with the pruning of diseased limbs and the gathering of rotting fruit, is apparently sufficient for Connecticut, but in more southerly states, where the trouble is often serious, the sprayings with Bordeaux are followed later in the season with Amm. Sol. Cop. Carbonate (Bulls. 111, p. 5; 142, p. 2).

BLACK MOLD, *Fumago vagans* Pers. See Pear.

BLACK ROT, *Sphaeropsis Malorum* Pk. Plate XI, a. One of the most common and universal troubles of the apple is black rot. Ordinarily this does not attack green fruit, except through insect injuries. It is most troublesome to the summer varieties at time of ripening and to fall and winter varieties after storage. The apples on rotting are brown at first, but usually blacken later, hence the common name. This fungus also occurs on the limbs, forming depressed, reddish, dead areas, or it may kill the young twigs by girdling. It is very common on the leaves, forming roundish or irregular reddish brown spots; and in this state most of the apple leaf spot troubles seem to be caused by it. So far only one spore stage has been found, and this places it with the imperfect fungi. The fruiting stage shows on the twigs as small black pustules, easily seen by the naked eye. The pear and quince are other hosts of the fungus. To fight this trouble, the trees should be thoroughly pruned of all dead limbs and twigs; the larger cankered areas, when found, should be scraped and painted; the trees should be given a winter spraying, followed by the ordinary treatment for scab. (Rep. 1893, p. 91; Bull. 142, p. 2.)

BLUE MOLD, *Penicillium glaucum,* Lk. This common saprophytic mold occasionally causes rot in storage apples. In a fruiting condition it is easily identified by the green blue spores that appear in clusters on the surface of the rotten fruit.

BROWN ROT, *Sclerotinia fructigena* (Pers.) Schrt. Occasionally this causes rotting of ripe apples. It does not seem to be specifically different from the brown rot of peach, *q. v.*

CROWN GALL. The crown galls on the apple have about the same appearance as those on the peach and plum, though it is not yet definitely known if they have the same cause. They form irregular knots or swellings at the crown or more commonly lower down on the roots. So far, in this state, the trouble has been seen only on young trees, chiefly nursery stock. There is some question just what the later effect is on the tree, but it is safest to reject all stock showing any signs of this trouble. In 1899, Dr. Sturgis set out on the Station grounds ten young trees affected with knot; part of these had the knots cut off, others had knots cut off and roots then treated with copper sulphate, and some were left with knots on. After three seasons of growth, these trees were dug by the writer and the roots carefully examined. Very little difference could be seen in any of the trees at this time and the knots had spread very little, if any. (See Report Conn. Pom. Soc. 1903, p. 43.)

EUROPEAN CANKER, *Nectria ditissima* Tul. Plate XII, d. This is found usually on old and neglected trees, where it gets started in the branches through wounds or possibly through winter killing. As it is perennial through its mycelium, the bark is prevented each year from forming over the wound, so that an enlarging canker is formed showing the annual layers of wood in concentric rings around the original starting point. If examined at the proper time with a hand lens, the small, red, globular fruiting bodies of this sac fungus can be seen clustered on the edges of the cankered area. All cankered limbs should be removed and the larger cut surfaces be given a coat of paint.

FLY SPECK, *Leptothyrium Pomi* (Mont. & Fr.) Sacc. Plate XI, d. The small black spots, similar to fly specks, produced by this fungus are usually clustered on the fruit in numbers from half a dozen to a hundred or more. The conditions favorable for sooty blotch also produce this fungus, so the two are often found together. The former trouble, however, proves to be the more serious as it is more abundant and evident. So far the writer has not found the fly speck fungus in a fruiting condition, though it is classified with the sac fungi. A similar fungus was sent to the Station on peach twigs in a fruiting condition, last year, so it is not unlikely that this fungus winters on the apple twigs.

LEAF SPOTS, *Phyllosticta* sps. Not unfrequently one finds species of the *Phyllosticta* fungi on the round brown spots on apple leaves and apparently the primary cause of these. As stated before, most of these leaf spots are caused by the black rot fungus. The fruiting stages of the two fungi are often found in the same spot. At yet little is known of the life history of these Phyllosticta fungi, but they are possibly summer stages of sac fungi.

PINK MOLD, *Cephalothecium roseum* Cda. During the fall of 1902, this fungus, which commonly occurs only on decaying vegetation, caused very serious loss to the apple growers of New York state and to a less extent in this state. The trouble developed after the apples were picked for storage. Its development was the direct result of badly scabbed apples, and a wet fall, since it was only through the scabby spots that the mold gained entrance to the fruit. These spots became covered with a luxuriant white growth of mycelial threads, which on producing the spores changed to a pinkish color. The mycelium also penetrated the tissues and caused the rot of the apple. Cold storage checked the trouble but did not prevent the rotting of the apples when again brought into a warm atmosphere. The prevention of this trouble requires a treatment that goes back to the prevention of scab.

POWDERY MILDEW, *Podosphæra leucotricha* (Ell. & Ev.) Salm. This is usually a pest only in nurseries, though occasionally found in orchards on sprouts at the base of the trees. It forms a cobweb-like growth on the leaves and on the young twigs a dirty whitish felt, within which are embedded the small brownish spherical receptacles of the asco-spores. It thrives best in nurseries where the blocks of trees are very closely planted, and may be avoided by thinner planting and spraying with potassium sulphide or Bordeaux mixture.

RUSTS, *Gymnosporangium macropus* Lk., *G. globosum* Farl. Plate XI, c, Colortype 2. Two rusts, similar in appearance, occur here on the apple leaves, the former apparently the more abundantly. The apple stages (*Ræstelia pirata* and *R. lacerata*) are the I or cluster cup stages of the mature forms which occur as "Cedar apples" on cedar trees in late April to June. Infection of the apple leaves takes place in May or June, producing bright orange-colored spots that begin to show prominently in July. The fringed cluster cups [Plate XI, c] appear on the under surface of these the latter part of July and August, and their spores carry the fungus back to the young cedar twigs for new infection. There is great difference in the susceptibility of different varieties of apple to the attack of these fungi. One often sees certain varieties of trees in the orchard and nursery badly infected while others are free. Selection of varieties, therefore, is one way of avoiding the trouble. Wealthy and Fallowater, apparently, rust badly. Cedar trees in the vicinity of the orchard should be cut down. Spraying, as yet, seems to have given poor results. [Rep. 1891, p. 161; Bull. 142, p. 2.]

SCAB, *Venturia inæqualis* (Cke.) Aderh. Plate XII, a-b. One of the fungi most widely discussed is the apple scab. This is partly due to its general distribution and its injurious nature, but also to the fact that it was one of the first whose control was attempted by the use of fungicides. It occurs commonly on the fruit and leaves; very rarely on the twigs. On the fruit it produces superficial olive-black "scabby" spots, that often cause the young fruit to become one-sided and stunted. Scabby fruit, also, is apt to wilt in storage and become rotten through infection with other fungi (see pink mold). On the leaves the scab colonies, one-quarter to one-third of an inch in diameter, are shown by a hand lens to consist of superficial fertile threads radiating out from a common center. The only specimens found on twigs [Plate XII, b] showed small pustules not unlike those of the black rot fungus. Apple scab is the parasitic summer stage (*Fusicladium dendriticum*) of a sac fungus that develops as a saprophyte on the fallen leaves during the fall and winter, maturing its spores in early spring in time for infection of the unfolding leaves. Spraying experiments have shown that this trouble can be controlled by Bordeaux mixture. The first treatment is given on the unfolding leaves before the blossoms open, the second just after the petals fall, and the third, if necessary, follows two or three weeks later. Sometimes a winter treatment with copper sulphate is given on the dormant wood, but this is hardly necessary. [Rep. 1893, pp. 72, 88; Bull. 142, p. 2.]

SOOTY BLOTCH, *? Phyllachora pomigena* (Schw.) Sacc. Plate XI, b. During the past two seasons this has been one of our most serious apple pests. The fungus forms a prostrate growth of matted threads, that in olive-black colonies more or less cover the surface of the fruit. Because of its superficial growth the fungus thrives best under moist conditions, such as the past two seasons have afforded. It attracts most attention on the lighter skin varieties, as the Greening, because of the contrast in color. The injury to the fruit, at first, is chiefly in its appearance, but this is sufficient to greatly affect the market value. Later, ill effects are shown in the keeping qualities, as badly spotted fruit wilts badly, because of the rupture of the cuticle covering the apple, and not infrequently rotting, from other fungi, develops. So far the writer has not found the mycelium on these blotches producing spores, though apples were kept out doors over winter for this purpose. The fungus, however, probably belongs with the sac fungi. It occurs less prominently on the pear. The treatment ordinarily given for apple scab proves beneficial in keeping this trouble in check. To be most effective, the third spraying should be given when the fruit has attained considerable size. [Rep. 1897, p. 171; Bull. 142, p. 2.]

Baldwin Spot. This trouble shows first in the fall as small sunken rotten spots on the surface of the fruit and later as isolated brown spots within the flesh, the tissue in these often collapsing. When first studied it was thought that fungi or bacteria might be responsible, but now it is generally considered a physiological trouble, possibly resulting from too great loss of water at these places. The trouble increases after storage, especially in the development of the internal spots. Very similar spots have been found in the interior of potatoes, which probably result from similar causes and conditions. During the past season Baldwin spot was more prevalent than usual, being common in Baldwins especially. The poor condition of apples, induced by the peculiar growing season, and by the September gale which shook most of the fruit from the trees, may possibly explain its greater prevalence.

Fruit Scald. This is a more serious trouble with cold storage apples than with those stored in the ordinary way. It shows as large brownish scalded places at first on the skin, but eventually penetrating deeper and is usually most prominent on fair skin varieties. While the cold no doubt has much to do with developing this trouble, it also seems certain that the condition of the apples as they enter storage is a very important factor. It is a trouble that is under investigation by our government pomologists.

Spray Injury. Injury to the foliage and the fruit often follows spraying with Bordeaux mixture, especially when combined with insecticides. Circular brown spots are produced on the leaves very similar to those caused by the leaf spot fungi and if the injury is sufficient many of these leaves are shed prematurely. The injury to the fruit shows as russeting, and may cause lop-sided growth. Carelessness in preparing the Bordeaux, failing to properly neutralize the copper sulphate with fresh lime, is sometimes responsible for these injuries. In wet seasons, injury sometimes results where proper precautions have been taken. As a rule, the earliest sprayings on the undeveloped leaves do not seem to cause injury so frequently as later sprayings on the fully matured leaves.

Winter Injury. Plates IX, a-b, X, b. As stated in the introduction, many apple trees were severely injured by the sudden zero weather of December 9, 1902. This was due to the sudden change following an open fall in which the trees had not properly matured for winter conditions. The winter of 1903-4 has also been a very severe one, but the trees were in better shape for it. The injury in 1902 was shown in two ways. First: In the nursery or very young orchard, especially where the trees were cultivated late and thereby taken into winter in an unripe condition, the injury was confined principally to the wood, the bark and the cambium remaining uninjured. This injury became evident only on cutting across the stem, when the wood [Plate X, b] showed a darker color than normal. When these trees were transplanted the following spring, the unfavorable conditions of a dry May and a wet June finished the career of many. When left in the nursery and severely pruned back they made a more or less satisfactory growth according to the severity of the injury. This new growth of wood showed as a white ring in striking contrast to the injured dark wood within. See Plate X. If the old wood was severely injured, even if the new wood grew fairly well, there was frequently developed an evident whitish fungous growth at the pruned surfaces on the injured wood, showing that there was trouble ahead from wood rot. Badly injured trees, too, were very brittle and easily broken off. Second: In orchards, most commonly on trees four to eight years old, the injury often showed as dead areas in the bark, usually at the base of the tree and more frequently on the northerly exposures. Sometimes these sunken areas completely girdled the tree, thereby finishing its career; again they extended a foot or two up one side, being separated by a fissure from the healthy bark. Trees injured severely in this way put out an abundance of healthy foliage early in the season and appeared in normal health until July, when the leaves began to drop. Plate IX, a, shows a young tree in Mr. Gold's orchard at West Cornwall, photographed in July, 1902, that was losing its foliage because of a similar injury to the base of the tree. These dead areas resemble cankered spots, and the writer mistook, at first, the injury at West Cornwall for a fungous trouble, since on some of the dead areas the fruiting pustules of a fungus [Plate IX, b] were found. Evidently these were developing as a later and saprophytic growth. The healthy bark with its lenticels, which are sometimes mistaken for fungous growths, is shown in Plate IX, c. Sun scald is also a winter injury of the bark due to warm weather, starting into activity the tissues on southerly exposures of the trunk, followed by a sudden freeze.

ASH, *Fraxinus* sps.

LEAF SPECK, *Piggotia Fraxini* B. & C. This produces very small black fruiting pustules on the under surface of the leaves of white ash.

RUST, *Æcidium Fraxini* Schw. This rust forms its cluster cups on the leaves and their petioles in July and August. Often it produces considerable distortion of the petioles where these spore cups are embedded. It was observed on the white ash, *F. Americana.*

ASPARAGUS, *Asparagus officinalis.*

ANTHRACNOSE, *Fusarium* sp. This trouble is sometimes associated with the rust on asparagus stems. It causes light-colored areas that become dotted with numerous pink pustules of the spores. The tissue is killed at these places and so where abundant the fungus may cause considerable injury.

LEOPARD SPOT. Apparently this is the result of some fungus, though it has not been found in a fruiting condition. It produces reddish brown spots usually with a distinct border.

RUST, *Puccinia Asparagi* DC. By far the most serious fungous pest of asparagus, however, is the rust. This shows as dark red or black pustules breaking through the skin on any part of the plant. These small pustules are usually oval in shape, though they may become more elongated, especially on the larger branches. The reddish color indicates the formation of the uredo- or summer spores, while the black color shows the presence of the teleuto- or winter spores. These different spores may even occur in the same pustules; they are most abundant from August to October. The cluster cup stage appears as early as June, but does little damage and so far has not been observed by the writer. During the past season the rust was later than usual in appearing and consequently less destructive. Some growers in Connecticut are now spraying against this trouble, but the work to be effective must be done thoroughly and repeatedly. Resin Bordeaux seems to be the best fungicide for this purpose because of its sticking qualities. Spraying should begin the latter part of July and be continued until the middle of September. Sometimes the dead fields in the fall are burned over to kill off at least some of the spores. According to some growers the Palmetto is more exempt from rust than most of the varieties. [Rep. 1896, p. 281; Bull. 142, p. 3.]

ASTER, *Callistephus hortensis.*

RUST, *Coleosporium Sonchi-arvensis* (Pers.) Lev. This rust has been found so far only sparingly on cultivated asters. In nature it is very common on wild asters and goldenrods. The bright orange uredo pustules appear in clusters on the under surface of the leaves.

STEM ROT, *Fusarium* sp? Some of our growers report as serious a stem rot or decay at the base of asters. This is probably caused by a Fusarium fungus, though no special study was made of this trouble, which evidently becomes established in the soil.

Yellows. Apparently this is a physiological disease, which may be similar to peach yellows. Affected plants are often spindling with some yellowish or whitish foliage and usually develop one-sided flowers imperfect in shape and color. Some growers think that the trouble becomes worse on ground used year after year.

AZALEA, *Azalea* sp.

RUST, *Pucciniastrum Vacciniorum* (Lk.) Diet. The uredo stage of this rust was seen in a local nursery doing considerable injury to certain cultivated azaleas, apparently native varieties. The rust showed on the under surface of the leaves as very small thickly crowded orange dots, while the upper surface was somewhat discolored by the injury to the tissues.

BARBERRY, *Berberis* sps.

ANTHRACNOSE, *Glœosporium Berberidis* Cke. In midsummer barberry leaves are often found showing at their tip or margin dead areas which in time may involve the entire leaf. These brown "tip burns" are separated from the healthy green tissue by a distinct purplish border. The very small fruiting pustules can sometimes be made out, on the underside near the healthy tissue, by aid of a lens.

RUST, *Puccinia graminis* Pers. The cluster cup stage of the common black stem rust of cereals occurs on both the wild and cultivated barberry. This appears in May embedded in slightly swollen clusters on the undersides of the leaves. See Oats.

BARLEY, *Hordeum* sps.

POWDERY MILDEW, *Erysiphe graminis* DC. The conidial stage (*Oidium monilioides*) of this mildew occurs on the leaves in greyish moldy tufts, causing discoloration of the tissues.

RUSTS, *Puccinia graminis* Pers., *P. rubigo-vera* (DC.) Wint. These common rusts cause considerable damage to barley raised for green fodder. See Oats.

SMUTS, *Ustilago nuda* (Jens.) Kell. & Sw. Plate XIII, a.

The loose smut is not uncommon in the spikelets of barley, changing them into dusty olive-black spore masses. The covered smut (*U. Hordei* (Pers.) Kell. & Sw.), which has a firmer blacker spore mass, has been seen but once. These troubles may be prevented by the modified hot water treatment of the seed.

BEANS: STRING, *Phaseolus vulgaris;* **LIMA,** *P. lunatus.*

ANTHRACNOSE, *Colletotrichum Lindemuthianum* (Sacc. & Magn.) Bri. & Cav. Plate XIII, c. This is a common trouble of beans. It occurs on both the pods and the leaves, producing on the former evident subcircular spots with a distinct reddish purple border. The bacterial trouble described later seems to be more common on the leaves than this, and most of the spots examined on bean leaves have been due to that. Anthracnose often gets started through infested seed; so only sound plump seed should be used. Destroying infected seedlings and the first diseased leaves should prove helpful in checking its appearance. Spraying with Bordeaux should begin when the plants are only a few inches high and be continued at intervals of two or three weeks until the pods are maturing. Burning the rubbish at the end of the season is recommended, since the trouble is probably carried by this in the soil. [Bull. 142, p. 3.]

BLIGHT, *Pseudomonas Phaseoli* Smith. Plate XIII, d. This is very common on the leaves of string beans, producing brown dead areas at the tip or margin or large irregular spots within, the leaf often turning yellowish all over and dying. Parts of these diseased areas often have a pellucid or water appearance. On the lima bean leaves, one often finds smaller reddish bordered spots distinct from the above and similar in appearance to those of anthracnose; yet even these seem to be of bacterial origin, probably started by insect punctures. See note by Sturgis in Report 1898, p. 262. The treatment for blight is the same as for anthracnose. [Bull. 142, p. 4.]

DOWNY MILDEW, *Phytophthora Phaseoli* Thaxt. Plate XIII, b, Colortype 12. This fungus was first described from specimens found near New Haven by Professor Thaxter in 1889. It occurs only on the lima bean and has since been found in a few other eastern states. It occurs most commonly on the pods, covering them more or less completely with a conspicuous white felt of the mycelium and summer spore stage. This distorts and often aborts the pods, rendering them unfit for the market. Less commonly the fungus attacks the flowers and young leaves and stems. It is most prevalent in moist seasons and in the low wet places in the fields. Too close planting of the vines also induces its development. Just how the fungus passes the winter still remains a mystery, as the winter or oospores have never been found, though looked for carefully by the writer and others. Probably the mycelium gains entrance to some of the seeds and it is carried over this way. Wet, low land should not be used and the plants should stand far enough apart to admit plenty of sunshine. Spraying every two or three weeks from the last of June until September is helpful in controlling the trouble. The first sprayings may be made with Bordeaux and the later with Amm. Sol. Cop. Carbonate. The diseased pods should be gathered at each picking. [Reps. 1889, p. 167; 1890, p. 97; 1893, p. 77; 1897, p. 159; 1898, p. 236; Bull. 142, p. 4.]

LEAF BLOTCH, *Isariopsis griseola* Sacc. (*Cercospora columnare* E. & E.) In one field this was found abundant, producing angular brownish areas of varying size and giving the leaves a sickly yellowish color. With a lens the fruiting stage can be seen, as small black columns with greyish bushy heads, standing out on the under surface of the leaves. It was also found on the old pods.

LEAF SPOT, *Phyllosticta phaseolina* Sacc. This was seen once. It produces large dark spots showing concentric markings.

MOLD, *Fusarium* sp. If beans are left too long in the field in the fall or if not properly matured when stored, this fungus develops a vigorous growth of white mycelium over and in the seeds.

RUST, *Uromyces appendiculatus* (Pers.) Lk. Plate XIII, e. This is very injurious to some varieties, including both dwarf and pole forms of the string beans. The small, roundish, dusty, reddish black pustules that usually thickly cover either surface of the leaves contain the uredo- and teleuto-spores. These occur occasionally on the pods. The rust is most common in August and September. Avoid planting varieties that rust badly, and burn the rubbish in the fall. [Bull. 142, p. 4.]

BEET, *Beta vulgaris*.

Leaf Blight, *Cercospora beticola* Sacc. Plate XIV, a. This is a very common trouble on beets and chard. The leaves are more or less covered with roundish spots, one-sixteenth to one-quarter inch in diameter, which have a greyish center and a purplish border. Only summer spores are known, placing it with the imperfect fungi.

Scab, *Oospora scabies* Thaxt. This causes scabby spots on the roots similar to those on potatoes. In an experiment, Sturgis found that "beets, mangels, turnips and ruta-bagas are susceptible to potato scab in a marked degree if planted on soil infested with the fungus causing that disease. None of these root crops, therefore, should occupy land which has recently borne scabby potatoes." [Rep. 1896, p. 266.]

BLACKBERRY, *Rubus villosus* and vars.

Crown Gall, *? Dendrophagus globosus* Toum. Reported on this host but not seen by writer. See Raspberry.

Leaf Spot, *Septoria Rubi* Westd. Plate XIV, b. This is a common trouble on the foliage, producing small, circular spots that eventually have a whitish center with a purple border. The fruiting pustules when present show as minute black dots sunken in the white area. It is caused by one of the imperfect fungi and occurs also on the raspberry and dewberry. It is questionable just how much damage this causes when fairly abundant, but if it proves serious, early spraying with Bordeaux would probably pay. [Bull. 142, p. 4.]

Orange Rust, *Gymnoconia interstitialis* (Schl.) Lagerh. Plate XIV, c, Colortype 9. This forms orange colored dusty outbreaks thickly covering the under surface of the leaves from May to July. At first these are covered by the epidermis, upon the rupture of which the spores are gradually scattered. Orange rust (*Cæoma nitens*) is the I stage of the mature form III, or teleutal, which occurs later in very inconspicuous pustules on the same plants. The mycelium is perennial in the underground parts of the host, so that shoots year after year from these will be rusted. The best remedy is to dig up and destroy the infected plants as soon as discovered; it is especially desirable to remove them early in the spring before the spore pustules break open. Certain varieties seem more subject to this trouble than are others, and it also occurs on the raspberry and dewberry and on wild plants of all of these. It is well to see that none of the latter flourish in the vicinity of the cultivated plants. [Rep. 1889, p. 172; Bull. 142, p. 4.]

BLUE GRASS, *Poa pratensis.*

POWDERY MILDEW, *Erysiphe graminis* DC. The conidial stage of this mildew often occurs on uncut grass in fence rows, etc. It forms a white powdery coating on portions of the leaves.

BOX ELDER, *Negundo aceroides.*

LEAF SPOT, *Phyllosticta minima* (B. & C.) Ell. See Maple.

BROME GRASS, *Bromus inermis.*

ERGOT, *Claviceps purpurea* Tul. Collected once on this and several times on other species of *Bromus;* sclerotia smaller than on rye, *q. v.*

BROOM CORN, *Sorghum vulgare* var.

GRAIN SMUT, *Sphacelotheca Sorghi* (Lk.) Clint. Collected in Experiment Station grounds. See Sorghum.

BUCKWHEAT, *Fagopyrum esculentum.*

LEAF BLIGHT, *Ramularia rufomaculans* Pk. Plate XIV, d. Occasionally this becomes abundant and injurious in buckwheat fields, but usually it is found only sparingly. Its fruiting stage forms whitish, mealy growths scattered in patches over the under surface of the leaves. This summer spore stage is the only one known. [Rep. 1890, p. 98.]

LEAF SPOT, *Ascochyta* sp. Another trouble occasionally found on the leaves produces circular, reddish brown spots. These and the fungus causing them are very similar, if not the same as the leaf spot of Rhubarb.

CABBAGE, *Brassica oleracea.*

CLUB ROOT, *Plasmodiophora Brassicæ* Wor. Plate XV, a. This forms gall-like enlargements on the roots. These are morbid growth of plant tissue, the cells of which are filled with the spores, etc., of the slime mold that produces the trouble.

Eventually the infected tissues rot, through the action of bacteria, and liberate these germs in the soil. Badly infected plants have little root hold in the soil and so are cut off from gathering sufficient plant food. They become spindling and head out poorly, if at all. The trouble becomes established in the soil when garbage is dumped on it or the refuse from the diseased crop is left in the fields. For this reason infected land is not adapted for raising cabbage or the similar cruciferous plants, cauliflower, turnip, etc. The disease even spreads to cruciferous weeds in the fields, as shepherd purse, and pepper grass. Rotation with different crops should be followed. The young plants should never be grown in infected soil. If an infected field is ever used, a fall coating with lime sown broadcast at the rate of eighty bushels per acre, is said to be helpful in keeping the trouble in check. [Bull. 142, p. 5.]

LEAF MOLDS, *Alternaria Brassicæ* (Berk.) Sacc., *A. Brassicæ* var. *macrospora* Sacc. These cause subcircular, blackish spots of varying size on the leaves. The variety seems to be the more common and has very large spores as seen under the microscope. The same fungus occurs on mustard and radish. Occasionally the trouble becomes rather prominent.

SOFT ROT, *Bacterial.* Often the leaves of the heads are more or less destroyed by a wet brown rot, which may become serious.

CARNATION, *Dianthus Caryophyllus.*

FAIRY RING, *Heterosporium echinulatum* (Berk.) Cke. This forms on the leaves greyish spots, about a quarter of an inch in diameter, having a distinct purplish border. The fruiting stage shown under a lens is an olive black, upright growth of threads. When occurring on the calyx, it often causes this to crack open, which is very objectionable to the growers. Usually the trouble occurs seriously only in neglected houses. [Bull. 142, p. 5.]

GREY MOLD, *Botrytis vulgaris.* Sometimes occurs on the blossoms. See Lettuce.

LEAF SPOT, *Septoria Dianthi* Desm. This often occurs with the preceding and the two look very similar. The leaf spot can usually be distinguished by the small black dots, or fruiting receptacles, that are embedded in the center of the spots. Only good plants should be selected for cuttings and all dead leaves removed as they appear. Care is needed in watering. It is easier to keep out these troubles by giving the plants the very best treatment than it is to control them after they are thoroughly started.

Rust, *Uromyces caryophyllinus* (Schrank.) Schrt. Plate XV, b. Rust is the most troublesome of the fungous pests of carnation. It breaks out in reddish brown dusty pustules on the leaves and stems. Both uredo- and teleuto-spores occur, but the former are more common. There is considerable difference in the susceptibility to rust with the various varieties. Eldorado, Daybreak, Jubilee, and others are said to rust badly. while Prosperity, Portia, etc., are more exempt. The conditions of different greenhouses and the care given by the growers also make differences in the amount of rust. Plants crowded too closely or watered too freely on the foliage and at improper times rust the worst. Many growers remove the rusted leaves, if not too numerous. No doubt *very careful attention* to this treatment when the plants are *first started* and little rust is found, would always repay. Spraying experiments have been carried on to some extent. Bordeaux mixture is objectionable to the grower on account of the sediment. Potassium sulphide to be of value should be applied in season, and repeatedly. [Bull. 142, p. 5.]

Stem Rot, *Rhizoctonia* sp. This sterile fungus was found in connection with the rot in one greenhouse. As the fungus lives in the soil, it is desirable to keep it from becoming established, since it will attack other plants as well.

Wilt, *Fusarium* sp. In the Report for 1897, pp. 175-81, Dr. Sturgis reports this troublesome to carnations grown in the Experiment Station greenhouse. Perhaps both this and the preceding fungus are responsible for the common stem rot trouble of growers. The soil, if necessary, can be sterilized with steam to rid it of these fungi.

CARROT, *Daucus Carota.*

Blight, *Bacterial.* While visiting a seed farm in the vicinity of Milford in 1902, there was observed a rather serious trouble of this host due to bacteria. The infected plants showed a wet rot, confined chiefly to the outer layers of the stem. These had a greenish black color, were watery and easily mashed out of place with handling. To a less extent the leaves showed blackened spots and the inflorescence was somewhat infected. An examination of these injured parts showed plenty of bacteria, which were, no doubt, the cause of the trouble, though no experimental or cultural work was undertaken with them. So far the writer has seen no description by others of this trouble on the carrot.

CATALPA, *Catalpa* sps.

Powdery Mildew, *Microsphæra elevata* Burr. In nurseries especially, but occasionally on the shade trees of lawns, this fungus is found coating the leaves on their upper surface with a more or less conspicuous cobweb-like growth. Imbedded in the dirty white mycelium occur the small black receptacles containing the winter or asco-spores. In the nurseries the trouble ought to be easily controlled by spraying with potassium sulphide.

CEDAR, *Juniperus Virginiana.*

Cedar Apples, *Gymnosporangium macropus* Lk., *G. globosum* Farl. Colortype 2. The teleutal stage of apple rusts occurs on this host. The "cedar apples" are reddish gall-like bodies that in the moist weather of spring send out elongated jelly-like horns all over their surface. These contain spores that germinate in position and produce smaller thin-walled spores, that, on the drying of the horns, are carried by the wind to the apple leaves, where their infection produces the cluster cup stage. The two species on the cedar are distinguished by the longer, more tapering horns of *G. macropus,* which is the more common species. See Apple.

CELERY, *Apium graveolens.*

Leaf Blight, *Cercospora Apii* Fr. The so-called "rust" of growers shows as reddish brown irregular spots on the leaves. If badly infected, these turn yellowish and have a sickly appearance. The fungus can usually be seen by a hand lens as a not very evident upright surface growth. This is one of the most serious troubles of the celery grower. At bleaching time rusty spots of this or the next fungus may appear on the stalks.

Where the trouble is likely to prove serious, spraying should begin soon after transplanting. Bordeaux is used for the first and usually Amm. Sol. Cop. Carbonate for the later sprayings. Applications should be made about every two weeks up to the time of banking. Sturgis found that dusting sulphur over the plants was also an effective treatment. [Reps. 1892, p. 44; 1893, pp. 81, 103; 1897, p. 167; Bull. 142, p. 5.]

LEAF SPOT, *Septoria Petroselini* var. *Apii* Br. & Cav. This is a trouble very similar to the preceding and the preventive treatment is the same. The two may occur together; but the leaf spot is usually distinguished by the small black dots, or fruiting receptacles, in the rusty spots.

CHARD, *Beta vulgaris* var.

LEAF BLIGHT, *Cercospora beticola* Sacc. See Beet.

CHERRY, *Prunus* sps.

BLACK KNOT, *Plowrightia morbosa* (Schw.) Sacc. Occurs injuriously on cultivated species and also on the wild species, *Prunus serotina* and *P. Virginiana.* See Plum.

BROWN ROT, *Sclerotinia fructigena* (Pers.) Schrt. Occurs on both *Prunus Cerasus* and *P. Avium.* See Peach.

LEAF CURL, *Exoascus Cerasi* (Fckl.) Sad. The leaves become badly discolored and somewhat deformed when attacked by this fungus. Those worst infected usually drop off. The trouble, apparently, is not common, but was collected a few times in 1900 by Sturgis.

LEAF SPOT, *Cylindrosporium Padi* Karst. Colortype II. The crowded, small, purplish spots produced on the upper surface of the leaves by this fungus are shown very well by the colortype frontispiece. On the under surface the spores frequently show as small, pinkish, agglutinated masses. Badly infected leaves turn yellowish and drop off. The trouble is one of the most common and serious occurring on the cherry; it also occurs on the wild black cherry, *P. serotina,* and occasionally on cultivated plums. Spraying with Bordeaux mixture, starting early in May, has successfully prevented the disease elsewhere. [Rep. 1890, p. 102; 1895, p. 188; Bull. 142, p. 6.]

POWDERY MILDEW, *Podosphæra oxyacanthæ* (DC) DeBy. Plate XV, c. This is most injurious to young trees. The under surface of the leaves, and to some extent the upper, becomes covered with the white mycelium of the fungus. In the fall, the winter spore stage is conspicuous, through the numerous small black perithecia (Plate XV, c) scattered among the fungous threads. The trouble can readily be controlled in the nurseries where it is injurious, by spraying either with Bordeaux mixture or potassium sulphide, if taken in time. [Bull. 142, p. 6.]

CHESTNUT, *Castanea sativa.*

ANTHRACNOSE, *Marsonia ochroleuca* (B. & C.) Humph. Colortype 5. This forms conspicuous spots with brownish centers and purplish borders, on the leaves. It is most injurious to young nursery trees, but probably could be prevented by proper spraying.

CHRYSANTHEMUM, *Chrysanthemum Sinense.*

ANTHRACNOSE, *Cylindrosporium Chrysanthemi* Ell. & Dearn. Greenhouse chrysanthemums sometimes suffer from this trouble. It produces large, brownish or blackish spots or blotches, sometimes covering the entire leaf.

POWDERY MILDEW, *Oidium Chrysanthemi* Rabh. This is a very common trouble in greenhouses, the leaves becoming covered with a mealy white growth. Apparently it is only the conidial stage of one of the Erysipheæ, but the winter stage is never produced. Ada Prass, Colonel Appleton, Omega, Merula and Julinda apparently mildew worse than Major Bonnaffon, Glory of Pacific, George W. Childs, or Ivory. The treatment for this should be the same as for mildew of rose, *q. v.*

RUST, *Puccinia Chrysanthemi* Roze. Plate XV, d. Only the uredo-stage of this rust seems to occur in this country on the chrysanthemum. This is a recent trouble, though one of the worst of this host. The dusty outbreaks of the reddish brown spores are about the size of a pin-head. These occur more or less abundantly on the under surface of the leaves. Attention should be given to the removal of infected leaves as soon as seen. Queen, Black Hawk, Ada Prass, Timothy Eaton, seem to rust worse than Miss Pullman, Major Bonnaffon, V. H. Hallock.

CLEMATIS, *Clematis Virginiana.*

LEAF SPOT, *Cylindrosporium Clematidis* Ell. & Ev.

CLOVER, RED, *Trifolium pratense.*

BLACK DOT, *Phyllachora Trifolii* (Pers.) Fckl. Colortype 6. The under surfaces of the leaves are usually rather thickly covered by the small black pustules of this fungus. It also occurs on white clover (*T. repens*) and crimson clover (*T. incarnatum*). It is not uncommon in clover fields.

BLACK MOLD, *Macrosporium sarcinæforme* Cav. This is also troublesome in some clover fields. It produces on the leaves reddish circular spots that often show faint concentric rings of development. The fruiting stage is very inconspicuous on these spots.

LEAF SPOT, *Pseudopeziza Trifolii* (Bernh.) Fckl. So far this fungus has not been found very common on the leaves, where it produces irregular reddish brown spots, in the center of which may sometimes be seen the small fruiting disc.

RUST, *Uromyces Trifolii* (A. & S.) Wint. Plate XVI, a. the æcidial or cluster cup stage was collected by Thaxter in June on white clover. Apparently this is not so common as the uredo- and teleuto-stages, which are found in July and August very commonly on red and white clover. They appear chiefly on the under surface of the leaves as reddish, dusty pustules. Perhaps this is the most abundant and injurious of these clover fungi; it is not uncommon to find two or more of them on the same leaves. [Reps. 1889, p. 174; 1890, p. 98.]

COLUMBINE, *Aquilegia* sp.

LEAF SPOT, *Ascochyta* sp. The large purplish blotches or diseased areas often seen on the leaves of cultivated columbines seem to be caused by a species of *Ascochyta,* one of the imperfect fungi.

POWDERY MILDEW, *Erysiphe Polygoni* DC. Occasionally this is found forming a whitish mycelial growth, with plenty of the perithecia showing as small black specks, scattered over the surface of the leaves.

CORN, *Zea Mays.*

BLIGHT, *Bacillus Zeæ* Burr. This usually occurs on the inner surface of the leaf sheaths, where it produces very evident dark purplish discoloration showing slightly through the sheath. Apparently it is not a serious trouble in Connecticut.

LEAF BLIGHT, *Helminthosporium turcicum* Pass. (*H. inconspicuum* Ell. & Ev.). Colortype 13. Last year this proved a very serious trouble to corn, many fields looking in August or September as if struck by an early frost. The very unfavorable season for maturing the corn was largely responsible for this unusual attack. Elongated areas or even entire leaves were killed, turning a brownish color and showing the fungus as a very inconspicuous surface growth. Conspicuous growths of other saprophytic molds, however, often appeared on these dead areas. Sometimes the dead spots were small, but usually, because of the venation, they developed into elongated areas. Not all fields were equally affected and it was difficult to always explain this. Possibly the maturity of the plants, or the character of the seed from which they came, was a partial explanation. Thaxter noted this as a serious trouble in Connecticut in 1889. [Rep. 1889, p. 171.]

RUST, *Puccinia Sorghi* Schw. Apparently this possesses no cluster cup stage. Both the uredo- and teleuto-spores develop as reddish, dusty outbreaks on either surface of the leaves, and can usually be distinguished by their color. While not an uncommon fungus in the corn fields, it does not often prove to be very serious.

SMUT, *Ustilago Zeæ* (Beckm.) Ung. Plate XVI, b. The conspicuous dusty smut balls of this fungus are familiar to every one. They break out on any part of the host and vary greatly in size and shape according to their situation. These smutty masses are composed entirely of spores. The trouble is most serious in sweet corn. Fresh manure applied to the land is likely to increase the amount of smut in corn, since the spores germinate in this and give rise, yeast-fashion, to numerous secondary germs that have the power of infecting the corn. This is practically the only cereal smut that can not be prevented by seed treatment, as infection takes place through any very young tissue. Some gather the smut balls to keep the trouble from spreading, but it is questionable just how much good this does. This smut is not poisonous to stock, as is supposed by some. [Rep. 1889, p. 171; Bull. 142, p. 6.]

COSMOS, *Cosmos bipinnatus.*

Leaf Spot, *Septoria* sp. Occasionally brown circular spots are produced more or less abundantly in the leaves by a *Septoria* fungus, whose fruiting bodies show as the usual little black dots in the tissues.

COSMOS, *Cosmus bipinnatus.*

Stem Spot, *Phlyctæa* sp. Halsted, of New Jersey, gives this as the cause of the large purplish blotches that appear on the stems, especially at the lower nodes. It may eventually produce a more or less serious rot of the stems.

CRAB APPLE (Bechtel's), *Pirus Ionensis* var.

Rust, *Gymnosporangium macropus* Lk. This occurs in its æcidial stage, I, on the branches, as well as on the leaves, but it does not seem to carry over the winter in the branches, as an examination last spring of those infected the year before failed to show any signs of a new development of the fungus. See Apple.

CROWFOOT, *Ranunculus* sp.

Powdery Mildew, *Erysiphe Polygoni* DC. Only the conidial stage was found forming a mealy whitish growth over the leaves.

CUCUMBER, *Cucumis sativus.*

Anthracnose, *Colletotrichum Lagenarium* (Pass.) Ell. & Hals. See Watermelon.

Downy Mildew, *Plasmopara Cubensis* (B. & C.) Humph. This fungus does not produce so conspicuous spots on the leaves of this host as it does on the musk melon; neither is the injury so severe. The fruiting stage, however, shows more conspicuously and with a lens the scattered growth of upright fertile threads bearing the large dark purple spores is easily made out. Spraying gives beneficial results with this host. Bordeaux should be used as soon as the vines begin to run and the treatments should be given often enough to keep the foliage well covered with the sediment. The cucumbers may be picked before each of the later sprayings, otherwise no attention need be given to keep the spray off the fruit. See Musk Melon. [Rep. 1890, p. 97.]

POWDERY MILDEW, *Erysiphe cichoracearum* DC. Conidial stage only occurs; on the leaves.

SCAB, *Cladosporium cucumerinum* Ell. & Arth. On leaves and fruit. See Musk Melon.

WILT, *Bacillus tracheiphilus* Sm. See Squash.

CURRANT, *Ribes rubrum.*

ANTHRACNOSE, *Glœosporium Ribis* (Lib.) Mont & Desm. This is the most serious trouble of the currant. It causes numerous purplish or reddish brown spots, about the size of a pin head, on the upper surface of the leaves. Where abundant, the intervening tissue is also killed and the leaf sheds prematurely. On the under surface of these spots the spores show in small pinkish globules. The trouble is often so serious that the bushes are completely defoliated by August, thus cutting short their season of usefulness. Spraying experiments, elsewhere, have controlled this disease. The first treatment is given before the leaves appear; the second as they are unfolding; others follow at intervals of about two weeks until the fruit begins to turn. [Bull. 142, p. 7.]

LEAF SPOT, *? Septoria Ribis* Desm. This forms larger and fewer spots than the last and the spores ooze out on the upper surface. Apparently it is not common. The spots and spores are not quite like those this fungus produces on the gooseberry, *q. v.*

RED KNOT, *Nectria Ribis* (Tode) Rab. Plate XVI, c. This was found on currants badly infested with the San José scale, which was chiefly responsible for the poor condition of the bushes. It is a question whether the fungus does not occur more commonly as a saprophyte than a parasite. It can be told by the bright red fruiting bodies that break out in roundish clusters on the stems. These are often accompanied by a conidial stage (*Tubercularia vulgaris*), which forms small roundish pink cushions producing the summer spores. It will do no harm to cut out all diseased branches.

DAHLIA, *Dahlia variabilis.*

POWDERY MILDEW, *Erysiphe cichoracearum* DC. Conidial stage only formed.

DANDELION, *Taraxacum officinale.*

POWDERY MILDEW, *Sphaerotheca Castagnei* Lev. Found sometimes on plants raised for greens.

DEWBERRY, *Rubus Canadensis.*

LEAF SPOT, *Septoria Rubi* Westd. See Blackberry.

ORANGE RUST, *Gymnoconia interstitialis* (Schl.) Lagerh. See Blackberry.

DOGWOOD, *Cornus* sps.

LEAF SPOT, *Septoria cornicola* Desm. This fungus produces numerous brownish or purplish circular spots, usually less than one-quarter of an inch in diameter, on the leaves. It was found doing considerable injury to both *Cornus sanguinea* and *C. paniculata* in nursery rows.

EGG PLANT, *Solanum Melongena.*

FRUIT MOLD, *Botrytis* sp. This is often responsible for the rotting of the fruit. Its spore stage shows as a dense greyish moldy growth covering the rotten area.

FRUIT ROT AND LEAF SPOT, *Phyllosticta hortorum* Speg. This was a serious trouble last year of egg plants, especially on the fruit. It causes round brownish spots on the leaves and the fruit gradually rots a reddish brown color, the spore pustules showing as black dots. The spores produced in the leaves are often septate and possibly larger than those on the fruit. A *Phlyctæna* spore stage also often occurs in the same pustules on the fruit with the *Phyllosticta*. This makes the systematic position of the fungus uncertain, though Halsted determines it as given above. The rotten fruit should be picked and destroyed.

LEAF MOLD, *Alternaria Solani* (E. & M.) J. & G. This forms spots on the leaves very similar to the above fungus. See Potato.

WILT. Last year the egg plants were often attacked by a fungus that caused wilting, yellowing and eventually the death of the leaves, especially the lower ones. This seemed to be the result of a *Fusarium* that invaded the fibro-vascular bundles of the stem and, by clogging the vessels, cut off the water supply of these leaves.

ELM, *Ulmus Americana.*

LEAF SPOT, *Gnomonia ulmea* (Schw.) Thm. Elm leaves are very commonly attacked by this fungus, its fruiting stage showing on the upper surface as small black pimples, often somewhat clustered in circles. The spores mature in the old dead leaves the following spring.

WHITE FUNGUS, *Sporotrichum globuliferum* Speg. Plate XVI, d. This is the fungus that was used some years ago by the Kansas and Illinois Experiment Stations in experiments to infect chinch bugs generally in the fields. In the summer and fall of 1902, it was found in Connecticut on the elm-leaf beetles, and as the next year the beetles were greatly reduced in numbers it no doubt had considerable influence in checking their ravages. The remains of the larvae were frequently found under the loose bark of the trees, embedded in a luxuriant white growth of the fungus (see Plate). Under a hand lens this shows the spores crowded into the numerous minute spore balls so characteristic of the fungus.

ENDIVE, *Cichorium Endivia.*

LEAF SPOT. A serious leaf spot trouble, apparently produced by a fungus but not in a fruiting condition, was observed in 1902 in the vicinity of New Haven. The leaves were so abundantly covered with the circular brown spots as to render them useless for the market.

RUST, *Puccinia Endiviæ* Pass. Apparently this rust has not been reported before in this country, though it is a common parasite of endive in Italy. It was probably introduced in New Haven from that country, for the only place it was found was in a large endive field owned by an Italian market gardener. As endive should have perfect leaves for bleaching, the abundant dusty pustules produced by the rust spoiled many plants or at least rendered them second class. Only the uredo-spores were found, even late in the fall.

GERANIUM, *Pelargonium* sp.

Grey Mold, *Botrytis vulgaris* Fr. This common mold occurs in leaky or too moist greenhouses. Water dropping on the plants from the roof often gives the fungus its chance for infection. Brown dead spots are produced on the leaves and under moist conditions these develop the grey, moldy growth of the fruiting stage.

Leaf Spot, *Ascochyta* sp. Produces large circular or irregular spots on the leaves; not very common.

Stem and Leaf Rot, *Bacterial.* Complaint is sometimes made of geraniums rotting off at their base or the leaves decaying or spotting. The trouble seems to be caused by bacteria and no doubt is often induced by too moist conditions. Affected parts or badly diseased plants should be destroyed.

GOLDEN GLOW, *Rudbeckia laciniata.*

Powdery Mildew, *Erysiphe cichoracearum* DC. Common, but not very injurious, and occurring only in the conidial stage.

Stem Rot. The writer's attention has been called to a stem rot trouble of golden glow that has appeared year after year in the same bunch. Each year the rot attacks some of the stems at their base, finally killing them by rotting the tissues and choking up the water ducts. The trouble is carried over in the soil by small black sclerotia, or compacted tubers of fungous cells, that are formed on the rotting stems. The trouble is probably caused by a *Botrytis* fungus.

GOOSEBERRY, *Ribes* sps.

Anthracnose, *Glœosporium Ribis* (Lib.) Mont. & Desm. Occurs occasionally on this host. See Currant.

Leaf Spot, *Septoria Ribis* Desm. Brownish or purplish spots, often having a whitish center, are formed on the leaves. The fruiting bodies, as minute black dots, may sometimes be seen in these. Apparently this is not a common trouble.

Powdery Mildew, *Sphærotheca mors-uvæ* (Schw.) B. & C. While this has never been collected by the Station botanists, it has occurred in the state, as shown by reference to it in one of the old Reports of the Agricultural Society, where it was named as a serious trouble varying in different seasons. It forms a dirty white felt of mycelium on the young branches and leaves and often on the fruit. Imbedded in this are the small reddish black perithecia, containing the asco- or winter spores. Spraying with potassium sulphide, beginning as soon as the buds burst and repeating every two weeks until the end of June, is said to hold this trouble in check.

GRAPE, *Vitis* sps.

ANTHRACNOSE, *Sphaceloma ampelinum* DeBy. The bird's eye rot occurs on the leaves, stems and fruit. On the latter it forms circular rotten spots with distinct, bright colored borders, hence the common name. This generally yields to treatment by spraying more readily than the next trouble. Diseased wood should be removed. [Reps. 1889, p. 174; 1890, p. 102; 1893, p. 98.]

BLACK ROT, *Guignardia Bidwellii* (Ell.) Viala & Rav. Plate XVII, a. This is the most common and injurious trouble of the grape. On the leaves it produces conspicuous, circular, reddish brown spots. In the small black dots imbedded in these are produced one of the summer spore stages (*Phyllosticta Labruscæ* Thm.) of the fungus. This stage also occurs on the leaves of the Virginia creeper and the Boston ivy, which are related plants. The grapes, on rotting, first have a brown color, but eventually dry up into wrinkled black mummies that adhere for some time to the vine. In these, a summer spore stage, similar to that on the leaves, is first produced, but other stages are also formed, the asco-spore form appearing the next spring. Black rot is a very difficult trouble to control, especially in wet seasons, but persistent spraying year after year reduces the trouble to a minimum. Spraying should begin before the blossoming period, about the last of May; the second application follows after the plants blossom, and others at intervals of ten to fourteen days. Bordeaux is used until the middle of July, and then Amm. Sol. Cop. Carbonate or Soda Bordeaux until the middle of August. The treatment should be thorough for a couple of years until the disease is under control, when the number of sprayings can be reduced from six or seven to three. [Reps. 1889, p. 174; 1890, p. 100; 1893, p. 96; Bull. 142, p. 8.]

DOWNY MILDEW, *Plasmopara viticola* (B. & C.) Berl. & De Toni. Plate XVII, b. This fungus occurs on grapes grown under glass, in the vineyards, and even more commonly on wild species. The thick, white felt that is produced on the under surface of the leaves, occasionally on the stems and fruit, bears the thin-walled summer spores; the thick-walled winter spores are rarely formed within the tissues. The treatment given for black rot should prevent this trouble also. When the vines are treated for this alone, perhaps the sprayings need not be so numerous. For grapes grown under glass, Sturgis found the fumes of sulphur safer to use. [Rep. 1893, pp. 77, 97; Bull. 142, p. 8.]

GREY MOLD, *Botrytis* sp. Ripe fruit of greenhouse grapes frequently rots by reason of a common *Botrytis* mold. Attention should be paid to the moisture conditions in these houses. Spraying the bunches with potassium sulphide or heating sulphur, probably would prove helpful. The rotting grapes should be removed as soon as they appear.

POWDERY MILDEW, *Uncinula necator* (Schw.) Burr. This mildew forms a cobweb-like growth on the upper surface of the leaves or occasionally destroys the fruit. In the fall the perithecia are easily seen as very minute reddish or black balls scattered over the surface of the infected leaves. The treatment for black rot should also prevent this. Where this alone is troublesome, the later sprayings may be made with potassium sulphide, if desired. Probably a very late spraying in the fall would prove useful in checking the trouble the next year. The Virginia creeper is also a host for the fungus. [Rep. 1895, p. 185; Bull. 142, p. 8.]

Winter Injury. A very curious trouble was seen the past summer on grapes grown under glass in New Haven. Apparently it was a result of the sudden freeze of December 9, 1902, since the greenhouse, contrary to the usual custom, was not heated that winter and the injury was greatest on the west or coldest side of the house. The trouble first showed during the summer in morbid, gall-like growths of plant tissue, that were formed usually at or toward the base of the vines. These excrescences were more irregular and not so dark colored as black rot. By early winter this morbid tissue was dead and somewhat pulverized by insect larvae. A similar trouble has been figured in one of the New York Experiment Station's bulletins on grapes grown outdoors; and has also been described in Europe. It has usually been ascribed to cold weather. As the wood on some of the vines described here also showed winter cracks, this is probably the explanation of the trouble.

GROUND CHERRY, *Physalis pubescens.*

WHITE SMUT, *Entyloma Physalidis* (Kalchb. & Cke.) Wint. The spores of the white smuts are permanently embedded in the tissues, and of light color, so they do not have the black, dusty appearance of the ordinary smuts. This smut of the strawberry tomato, or ground cherry, forms whitish or reddish angular spots on the leaves and is sometimes so abundant as to cause serious injury to the foliage. The character of the host, however, makes it of little economic importance.

HAWTHORN, *Cratægus* sps.

LEAF SPOT, *Entomosporium Thümenii* (Cke.) Sacc. This produces small angular reddish or purplish brown spots on the leaves of the English hawthorn, *Cratægus oxyacantha,* which is sometimes grown in yards.

RUSTS, *Gymnosporangium macropus* Lk., *G. clavipes* C. & P. Æcidial stages occur on leaves of cultivated redhaws.

HAZEL, *Corylus* sp.

BLACK KNOT, *Cryptosporella anomala* (Pk.) Sacc. Plate XVII, c. This fungus sometimes becomes very injurious to the ornamental cut leaf hazel. In one nursery it proved so destructive that the owner intended giving up growing this variety. The black knot infects the branches, breaking out between the bark as oval bodies about one-quarter of an inch in length, in the surface of which are embedded the fruiting pustules.

HICKORY, *Carya alba.*

ANTHRACNOSE, *Glœosporium Caryæ* Ell. & Dearn. This forms dark purple blotches on the leaves.

HOLLYHOCK, *Althæa rosea.*

LEAF BLIGHT, *Cercospora althæina* Sacc. The numerous, small, angular spots produced on the leaves by this fungus are reddish brown, often with a lighter center.

LEAF SPOT, *Ascochyta parasitica* Fautr. This sometimes occurs on spots associated with a rust pustule.

RUST, *Puccinia Malvacearum* Mont. Plate XVII, d. Rust is the most common trouble of hollyhocks and the one most frequently sent to the Station for determination. The fungus shows as roundish cushions, of a light or dark red color, on both leaves and stem. Only teleuto-spores are known and these germinate in position so that the pustules are often covered with a whitish growth due to this germination. Some think the trouble is partially controlled by spraying, but this to prove of benefit should begin before the appearance of the rust pustules. Possibly the trouble might be checked the next year, if in the fall the plants were all cut off below the ground and all of the rubbish destroyed by fire. [Rep. 1895, p. 188.]

HONEYSUCKLE, *Lonicera* sp.

POWDERY MILDEW, *Microsphæra Loniceræ* (DC.) Wint. Observed occasionally on Tartarian honeysuckles in old gardens.

HORSECHESTNUT, *Æsculus Hippocastanum.*

LEAF SPOT, *Phyllosticta Paviæ* Desm. A very serious leaf trouble of the cultivated European horsechestnut is caused by this fungus. The large dark red blotches often reach from the margin to the midrib and resemble sunburn. On the upper surface the minute black dots of the fruiting stage are often visible.

HORSERADISH, *Cochlearia Armoracia.*

LEAF BLIGHT, *Ramularia Armoraciæ* Fckl. This is the fungus ordinarily reported on horseradish, but it does not seem so common here as the next two. The spots are smaller and paler and the leaf tissue often falls out, giving a shothole effect.

LEAF MOLD, *Macrosporium herculeum* E. & M. It is questionable if this is distinct from *M. Brassicæ* var. *macrospora*, which is reported here on cabbage and other cruciferous plants.

This can usually be told from the other leaf troubles of this host by the brown spots, starting as black dots, forming concentric rings of development. The spots are about one-quarter of an inch in diameter.

Leaf Spot, *Cercospora Armoracia* Sacc. Plate XVII, e. The fruiting stage often shows as an inconspicuous upright growth on the surface of the subcircular brown spots.

INDIAN CURRANT, *Symphoricarpus vulgaris.*

Powdery Mildew, *Microsphæra Symphoricarpi* Howe. In nurseries this proves a common trouble, covering the upper surface of the leaves usually with a dense white growth of the summer spore stage, and producing an abundance of the perithecia on the upper surface or, more scattered, on the under side of the leaves.

IRIS, *Iris* sps.

Leaf Blight, *Heterosporium gracile* (Wallr.) Sacc. This is a very serious trouble of the Iris, especially of *Iris Germanica.* The prominent elliptical spots appear scattered over the leaves, which often turn yellowish and die at the tips.

Rootstock Rot, *Bacteria.* Plate XIX, a. In one of the nurseries, last season, this trouble was common on *Iris Germanica* and *I. cristata.* Apparently the disease had been greatly aggravated by burying the rootstocks too deeply when transplanted that spring. The wet season, too, was favorable for the development of the trouble, which, according to the manager, was unusually severe. The rootstocks were rotted off by a wet bacterial rot, which sometimes extended up into the base of the outer leaves. Apparently this is the same trouble that has recently been described from Germany [Zeitschr. Pflanzkrankh. **13**: 129-44, 1903.] Dr. van Hall, who studied the trouble there, found three organisms associated with the rot, of which *Bacillus omnivorus* apparently was the chief. The writer made no cultural studies.

Rust, *Puccinia Iridis* (DC.) Wallr. On the wild species of Iris this is a very common rust, but it was found only once on a cultivated species. It produces the ordinary dusty reddish pustules, thickly covering the leaves. So far only the uredo-stage (*Uredo Iridis* DC.) has been found here.

IVY, BOSTON, *Ampelopsis tricuspidata.*

LEAF SPOT, *Phyllosticta Labruscæ* Thm. This is apparently the same as the leaf spot form of black rot of grapes.

KŒLREUTERIA, *Kœlreuteria paniculata.*

RED KNOT, *Nectria cinnabarina* (Tode) Fr. Colortype 3. This occurred in a nursery doing serious injury to this Japanese tree. On the sunken, cankered areas reaching clear into the wood, there was found an abundance of the small, spherical, bright red perithecia of the fungus. There was some question, however, whether winter injury did not form the starting point of the trouble.

LAVATERA, *Lavatera* sp.

RUST, *Puccinia Malvacearum* Mont. See Hollyhock.

LETTUCE, *Lactuca sativa.*

DOWNY MILDEW, *Bremia Lactucæ* Regel. Lettuce, both in and out of doors, is sometimes bothered by this fungus. It produces brownish dead areas which usually show on the under side whitish tufts of the fertile threads of the fungus. As it is a trouble that thrives best in moist places, care in watering greenhouse plants is helpful in controlling it. [Bull. 142, p. 9.]

GREY MOLD, *Botrytis vulgaris* Fr. This causes a rotting or spotting of the leaves, upon the dead portion of which the fruiting stage develops as an erect greyish mold. It is common in moist greenhouses and is apparently the same Botrytis that develops on a great variety of plants under moist conditions. The stem rot of onions, the grey mold of grapes and the fruit mold of egg plants are possibly caused by different species.

LEAF SPOT, *Septoria consimilis* Ell. & Mart. This can be identified by the fruiting stage, which shows as very small black dots in the spots or dead areas it produces on the leaves. Like the other troubles, care in watering indoor lettuce and the removal of diseased leaves as soon as they appear, will help to keep it in check. It will pay the greenhouse grower never to allow any wilted or dead leaves to remain either on the plants or on the soil.

LILAC, *Syringa vulgaris.*

Powdery Mildew, *Microsphæra alni* (Wallr.) Wint. Every one has noticed this on the upper surface of lilac leaves. Both spore stages are produced abundantly.

LILY OF THE VALLEY, *Convallaria majalis.*

Leaf Blotch. During the summer and fall the leaves of this plant commonly become discolored with purplish blotches, which often run together into large areas. So far no fungus has been found in a fruiting condition on these leaves, but the trouble appears to be of fungous origin.

LILY, WHITE DAY, *Funkia subcordata.*

Anthracnose, *? Colletotrichum* sp. Produces subcircular brown spots with purplish borders.

LINDEN, *Tilia* sp.

Black Mold, *Fumago vagans.* The linden trees of a park in Bridgeport were found coated on their upper surface with this fungus, which gave them a sooty appearance.

MAHONIA, *Mahonia Japonica.*

Leaf Spot, *Phyllosticta Japonica* Thm.

MAPLE, *Acer* sps.

Anthracnose, *Glœosporium saccharini* E. & E. Irregular dead areas, often of considerable size, are produced by this fungus, giving the appearance of sunburn.

Black Spot, *Rhytisma acerinum* (Pers.) Fr. On *Acer dasycarpum.* This forms black, slightly elevated "finger prints," about ½ inch wide, on the upper surface of the leaves. The lower surface is often concave and not so dark colored. The sac fungus producing these does not mature its spores until some time after the leaves have fallen from the trees.

Leaf Spot, *Phyllosticta minima* (B. & C.) Ell. (*P. acericola*) *On Acer dasycarpum, A. pseudoplatanus var.* Causes reddish or brownish circular spots about ¼ inch in diameter.

MARIGOLD, *Tagetes* sp.

GREY MOLD, *Botrytis vulgaris* Fr. On blossoms. See Lettuce.

MATRIMONY VINE, *Lycium vulgare.*

POWDERY MILDEW, *Erysipheæ undet.* Conidia only.

MIGNONETTE, *Reseda odorata.*

LEAF BLIGHT, *Cercospora Resedæ* Fckl. Not infrequently this fungus produces small whitish spots on the leaves.

STEM ROT, *Rhizoctonia* sp. In one greenhouse this was found doing some damage to the plants. The stems were rotted off at the base, the leaves turning yellowish. Where the leaves came in contact with the moist ground, they also started to rot.

MUSK MELON, *Cucumis Melo.*

ANTHRACNOSE, *Colletotrichum Lagenarium* (Pass.) Ell. & Hals. See Watermelon.

DOWNY MILDEW (BLIGHT), *Plasmopara* Cubensis (B. & C.) Humph. Plate XVIII, a-b. This trouble has been prominent at least during the past three years, though last year it was not nearly so serious as the year before. As it is a trouble that comes and goes, this may indicate that it is on the wane again. The disease first shows during the latter part of July or early August, when large, brownish, angular spots appear on the leaves. If the season is favorable, the leaves become thickly covered with these, the intervening green tissue dies and the leaf dries up on its stalk. In a very few days the trouble may spread so rapidly that it kills practically all of the leaves. This often occurs before any of the fruit matures, and what little does ripen lacks flavor. In moist weather, by looking closely at the under surface of the leaves with a magnifier, the fruiting threads can be seen at the juncture of the green and dead tissue, as a scanty, dark purple, upright growth. The color is due to the very large purplish summer spores which are borne on the ends of these fertile threads. The winter, or oospores, have never been found, though the writer has searched for them at all seasons of the year. It is not known how the fungus passes the winter in this state. Possibly it does not winter so far north, or possibly it is carried over on greenhouse cucumbers. Any curcubit is likely to be attacked by it, but so far it has been observed here only on the common and English cucumbers, on musk melons and rarely on watermelons. During seasons when the trouble develops very seriously, it is questionable if spraying yields any very striking results with musk melons, though it does give good results with cucumbers. During ordinary seasons, however, this, and most of the other troubles of the musk melon, can be held in check by thorough and repeated sprayings with Bordeaux. The first application should be made as soon as the vines begin to run. [Rep. 1899, p. 277; Bull. 142, p. 10.]

LEAF MOLD, *Alternaria Brassicæ* var. *nigrescens* Pegl. (*Macrosporium cucumerinum* Ell. & Ev.) This fungus also produces brownish spots on the leaves that can scarcely be distinguished by the naked eye from those of the preceding fungus. It occurs also on the watermelon. While not an uncommon trouble, it is not usually so serious as the downy mildew. The treatment is the same. [Reps. 1895, p. 186; 1896, p. 267; 1898, p. 233; 1899, p. 272; Bull. 142, p. 10.]

SCAB, *Cladosporium cucumerinum* Ell. & Arth. (*Scolecotrichum melophthorum* Pr. & Del., *Cladosporium cucumeris* Frank.) Plate XIX, b. This has been reported several times in this country on cucumbers, and in Europe on both cucumbers and musk melons. Last season it was found in this state, on both hosts, but doing most injury to melons. It appeared about the first of August, producing sunken areas on both stems and fruit. The mycelium produces these by collapsing the tissues and then forms on the outside a dense olive growth of a summer spore stage—the only one known. Apparently, the trouble thrives only in very moist weather.

WILT, BACTERIAL, *Bacillus tracheiphilus* Sm. Occasionally occurs, doing damage; see Squash. Bacteria also produce a leaf spot trouble, but probably this is only another form of the wilt disease. [Rep. 1898, p. 225.]

WILT, FUNGUS, *Neocosmospora vasinfecta* (Atk.) Sm. In appearance this is the same as the preceding, but the *Fusarium* stage of the *Neocosmospora* fungus clogs up the water ducts of the stem and produces the wilt. Apparently it is not as common as the bacterial wilt. [Rep. 1898, p. 228.]

Spray Injury. Bordeaux mixture sometimes slightly injures the foliage. In these cases the leaves turn yellowish at the margin and may die prematurely if severely injured. Occasionally the fruit shows some distortion or the scar of the blossom end becomes greatly exaggerated.

Sun Burn. Sturgis described a similar trouble which he called leaf burn, and ascribed to a sudden disturbance of the equilibrium between water absorption and evaporation. "When cool, cloudy weather alternates with hot sunshine, it is frequently noticed that the large leaves near the center of the hills turn yellow at their margin. Later, these yellowed margins become brown and dry and finally the whole leaf is diseased." [Rep. 1898, p. 228.]

MUSTARD, *Brassica* sp.

Leaf Mold, *Alternaria Brassicæ* (Berk.) Sacc. See Cabbage.

OAK, *Quercus* sp.

Powdery Mildew, *Microsphæra quercina* (Schw.) Burr. The cultivated English oak, *Quercus robur,* frequently has this mildew on its leaves.

OAT GRASS, *Arrenatherum avenaceum.*

Smut, *Ustilago perennans* Rostr. The smut destroys the grain, but the fungus is not of economic importance since the host is rarely grown here.

OATS, *Avena sativa.*

Black Stem Rust, *Puccinia graminis* Pers. Plate XIX, c. This rust produces elongated outbreaks on the stems and leaf sheaths. These are at first the reddish, uredo-stage, but later the black, teleuto-stage. The stems are weakened by the action of the fungus and badly rusted grain is apt to lodge. The barberry is the host for the æcidial stage, but apparently the fungus often skips this step in its life cycle. Black rust also occurs here on red top and timothy. This rust very commonly occurs with crown rust, and the injury they cause to the crop of oats is sometimes considerable. Very little can be done to lessen these troubles. [Rep. 1889, p. 174.]

CROWN RUST, *Puccinia coronata* Cda. Plate XIX, d. This is common on the leaves, producing first the small, dusty, red uredo-stage, and later the blackish teleuto-stage firmly imbedded in the tissues. These outbreaks are not nearly so elongated or prominent as in the preceding. It is called crown rust because the teleuto-spores have curious, horn-like projections.

SMUT, *Ustilago Avenæ* (Pers.) Jens. Plate XIX, e. This forms the common, dusty, blackish masses that completely destroy the grain. The covered smut, *Ustilago levis,* less completely destroys the grain, often being confined to the inner basal parts; neither is it as common here. Both of these smuts can be prevented by seed treatment with formalin or hot water. [Bull. 142, p. 10.]

ONION, *Allium* Cepa.

BLACK MOLD, *Macrosporium Porri* Ell. Apparently this does more or less damage to onions. It is found on "blighted" onions and probably is partially responsible for the trouble. Thaxter describes and figures this in the Report for 1889, p. 161. The fungus probably belongs under the genus Alternaria rather than Macrosporium, if these two genera are distinct.

BLACK SPOT, *Vermicularia circinans* Berk. Plate XX, a. It is on the stored onions that this trouble becomes prominent. Black blotches, made up of the small black fruiting pustules, appear on the outer dry coats of the onion and gradually work through a few beneath. While not causing a rot, this trouble seriously affects the appearance of the onion, especially the white varieties, and thus lessens their market value. So far the only means of lessening it is the best care in drying and storing the crop. Some have advocated the use of air-slaked lime scattered over the onions, but no definite experiment has been undertaken to show the value of this. [Rep. 1889, p. 163; Bull. 142, p. 11.]

DOWNY MILDEW, *Peronospora Schleideni* Ung. Thaxter found this fungus causing serious injury to the onions at Wethersfield in 1889. It has not been seen by the writer, though it probably still causes trouble occasionally. Usually the whitish growth of the mildew is not very prominent and may be obscured by the presence of the black mold fungi. Through the action of the mycelium, whitish or yellowish spots are produced in the tissues and the injury may become so severe that a blighting of the vines results. The fungus occurs in the fields as early as July. Spraying experiments conducted in Vermont showed that the trouble could be partially controlled in this way.

ROT, *Bacterial.* Stored onions are sometimes destroyed by a soft rot due to bacteria. Sometimes the whole onion rots or only certain layers may go. If the outer ones are rotting, they give a slippery feeling upon pressure with the hand. Maggots often accompany or follow this trouble.

SMUT, *Urocystis Cepulæ* Frost. This produces black, dusty pustules on the leaves and bulbs. It may be found early in May on the seedlings or late in the fall on the mature bulbs. The former are often killed outright and the stand seriously affected. The smut may become established in the soil and then it becomes more and more difficult to raise onions on this land. Considerable land valuable for onion culture has become unavailable for this purpose. It has been found that the sets do not smut, to any great extent, and that seed onions germinated in free soil and later transplanted to the infected soil also remain nearly free from smut and that the transplanting increases their size. Preliminary experiments by Thaxter and later work by Stewart, of New York, and Selby, of Ohio, show that the treatment of infected soil with certain chemicals will also lessen the amount of smut. One of the most feasible treatments seems to be the use per acre of 100 lbs. of sulphur, thoroughly mixed with 50 lbs. of air-slaked lime, which is drilled into the rows with the seed. Another remedy is sprinkling formalin over the seed before covering. Ground lime, drilled into the soil at the rate of 75 to 125 bushels per acre, has also been used. [Reps. 1889, p. 129; 1890, p. 103; 1893, p. 99; 1895, p. 176; Bull. 142, p. 11.]

STEM ROT, *Botrytis* sp. Plate XX, b-c. In Europe there is a *Botrytis* bulb rot of onions and hyacinths that is possibly the same as that described here. It is known there in its perfect stage as *Sclerotinia bulborum.* This trouble has occasionally occurred in Connecticut before, but apparently never so seriously as during the past two years. There is a possibility that it is not specifically different from the common Botrytis trouble of our greenhouse plants. The same trouble has been reported before by Halsted, of New Jersey, and during the past two years has occurred also in Massachusetts and, perhaps, elsewhere. Only the Southport White Globe seems to have suffered very severely from the rot. This variety is largely grown in Connecticut along the Sound from Green's Farms to Guilford. The onion growers of Green's Farms and Southport have suffered especially. In 1902 their loss was estimated at least $50,000, and in 1903 the crop did not nearly pay expenses. Some growers stopped sending their onions to market, since the returns per barrel paid little more than the freight. One grower near Branford was able to market only about 400 bushels out of 1,200 harvested, but these brought him very high prices.

The stem rot does not appear until after the onions are stored in the fall. Crops that were supposed to be in a fair shape when stored have rapidly disappeared with the trouble in October and later. The onions are sorted and the good ones sent to the market, but apparently these rot very seriously in transit. The trouble is called stem rot, because it begins at the stem end of the onion, which becomes soft to pressure at this place due to the rotting of the inner layers. The rot does not seem to usually spread from onion to onion, since the outer, drier layers are generally the last to rot. Plate XX, b, shows the top view of a rotting onion, while a cross section of the same onion is shown in Plate XX, c, where it is seen that only a few of the inner layers have rotted. Upon the exterior, drier layers, there often develops a dense growth of the olive-grey fertile threads of the summer stage. With these are sometimes found the small black sclerotia, or resting condition of the mycelium, that carry the fungus over the winter and apparently in the spring develop the Botrytis stage. A Sclerotina or ascostage has not been seen here. According to the writer's observations, this fungus in its Botrytis stage spreads as a parasite on the green leaves and on the blossoms in the fields as early in the season as July. It causes yellowish spots on the leaves and blasts the flowers. Wet weather is especially favorable for its development and this accounts for the unusual injury during the past two seasons. Wet weather, when the onions are drying in the field, undoubtedly is very favorable for the development of the mycelium into the bulbs from the drying stems; however, it is only after their storage that the real stem rot begins. Probably a moist fall after the storage also aggravates the trouble.

So far no remedies have been tried to prevent the trouble. Unusual care in curing and storing the crop apparently does not stop it. The character of the land, whether new or old in onion culture, seems to have had little influence. The very general prevalence of the disease points to the wet seasons as the chief factor for its development, and if a dry season should now follow, the chances are that the trouble would lessen very greatly. Attention should be called to the old rotting onions as a means of carrying the fungus over the winter by means of the black sclerotia. These onions should not be used as a fertilizer on the land. The fact that the fungus occurs in summer as an active parasite on the plants indicates that possibly spraying, by keeping the plants free from it during the growing season, may lessen the chances of the bulbs rotting late. If onions are sprayed, the first treatment should be given very early in July. Resin Bordeaux will probably prove the best fungicide to use, since the ordinary Bordeaux may not adhere readily to the plants. The sprayings should be repeated at least three times. This treatment is recommended only as a possible remedy. [Bull. 142, p. 11.]

YELLOW LEG OR BLACK MOLD, *Macrosporium parasiticum* Thm. This trouble is caused by a close relative of the fungus described under Black Mold. Thaxter found it often associated with the Downy Mildew, but he considered it a true parasite. It was found in 1902 by the writer, doing considerable damage to seed onions in the vicinity of Milford. Conspicuous yellowish or whitish areas are produced on the leaves and these become coated with a luxuriant black growth of the fruiting mold. Spraying ought to prevent this trouble.

ORCHARD GRASS, *Dactylis glomerata.*

ERGOT, *Claviceps* sp. The sclerotia are smaller than those of the rye ergot.

PARSLEY, *Petroselinum sativum.*

LEAF SPOT, *Septoria Petroselini* Desm. Under the action of this fungus the leaves, or parts of them, turn whitish and become speckled with the minute black spore receptacles imbedded in the tissues. More rarely the fungus produces distinct circular whitish spots in the green tissues. A variety of this fungus occurs on celery.

PARSNIP, *Pastinaca sativa.*

LEAF BLGHT, *Cercospora Apii* var. *Pastinacæ* Farl. This is only a variety of the common leaf blight of celery. It has not been found doing any considerable injury to the parsnip.

PEA, *Pisum sativum.*

LEAF SPOT, *Ascochyta Pisi* Lib. While this is a very common trouble with peas it is only occasionally that it causes severe injury. Roundish or angular spots are produced on both the leaves and pods. These are about one-quarter of an inch or less in diameter and usually have a distinct narrow purplish border. [Rep. 1899, p. 280.]

POWDERY MILDEW, *Erysiphe Polygoni* DC. The powdery mildew is likely to be found on the peas late in the season after they have passed their prime. Sometimes, however, it comes earlier and causes more severe damage. The leaves, stems and fruit become coated with a more or less prominent whitish powdery coating of the mycelium and summer spores; later, the small, blackish perithecia of the asco-spores are produced. Spraying with potassium sulphide should control the trouble.

PEACH, *Prunus Persica.*

BACTERIAL SPOT. During the past season, leaves of peach were received from an orchard in Pomfret that were covered with small, reddish brown, angular spots less than one-eighth of an inch in diameter. An examination of the diseased tissues under the microscope showed an abundance of bacteria, which were apparently the cause of the trouble. The spots were very similar to those produced on the leaves by the scab fungus or by spraying injury, and the tissues showed a tendency to fall out, giving a shot-hole effect. As 1903 was a season very favorable for the development of bacterial troubles, in normal seasons this bacterial spot may not prove serious.

BROWN ROT, *Sclerotinia fructigena* (Pers.) Schrt. Plate XXI, b. The fruit is the part of the host most severely injured by this fungus. About the time of ripening it may begin to decay, and if the weather is moist, the brown rot spreads rapidly. The ordinary rot of the peaches bought in the market is caused by this fungus. The brown rotten areas rapidly involve the entire peach, and the summer fruiting stage usually shows in the small, dusty, closely packed pustules breaking out on the surface. The disease is not confined to the fruit, but the young twigs and sometimes the leaves are killed. In some cases the mycelium apparently passes down into the branches from the diseased fruit. In wet springs the fungus also sometimes blasts the blossoms. Brown rot is one of our most injurious fungous foes, since in wet years thousands of baskets of peaches are destroyed by it. Usually it is most troublesome with the early varieties. Plums and cherries are also seriously affected by it, while apples, quinces and pears are less subject to this rot. The fungus passes the winter in the diseased branches, and also in the mummied, rotted fruit; the mycelium in these giving rise to new summer spores in the spring. Norton, of the Maryland Experiment Station, has recently found the mature stage of the fungus developing from the mummied fruit buried in the ground. This consists of a narrow pedicle expanding above the ground into a saucer-shaped receptacle that contains the winter or asco-spores. This then is another means of carrying the fungus from one season to another. So far, this stage has not been found in Connecticut.

It is evident that all rotten fruit should be destroyed by fire, and that all mummies should be carefully removed from the trees and the ground each season after the harvest time. During the ripening period, all rotten fruit should be gathered promptly, in order to check the spreading of the trouble. Where fruit sets very abundantly, the common practice of thinning also serves to keep down the trouble later. A good many spraying experiments to prevent brown rot have been recorded, some of which evidently have proved successful; but it is a difficult disease to combat in this way, both because of the rapidity with which it spreads in moist weather, and because of the injury that is likely to result to the foliage from the use of fungicides. Where spraying is to be tried, perhaps the best treatment would be a winter spraying with Bordeaux, given as for leaf curl, followed by two or three sprayings about picking time with potassium sulphide or copper acetate. [Reps. 1889, p. 171; 1893, p. 95; 1894, p. 138; 1898, p. 261; 1900, p. 232; Bull. 142, p. 12.]

CROWN GALL, *Dendrophagus globosus* Toum. See Plum.

CROWN OR FOOT ROT. This trouble is confined to the region of the tree near the juncture of the stock and scion, usually just below the ground. The most peculiar character is the ease with which the trees are broken off at this place. By pushing them from side to side by hand, they will often crack off sharply and sometimes they are even broken off by the winter winds. The trouble is not usually found in the nursery, but it has been seen in young orchards only set out one or two years. It is most conspicuous, however, in the older orchards. The trunk or roots become enlarged at the crown, so that it is sometimes called "club root." Upon breaking off the trees the woody growth is seen to be abnormal here, having become spongy and brittle and thus allowing easy fracture. On this account it is known also as "spongy root." The cortex is abnormally developed and appears diseased. The trees usually show the trouble some years before dying. They cease to grow; the foliage gradually becomes scantier, and often has an unhealthy appearance. The trouble is not uncommon in the peach orchards of the state, and was first described by Sturgis in the Report of the Pomological Society for 1901, p. 235. The owner of one orchard of about thirty acres, examined by the writer, stated that he had removed one year about 400 trees and since then a few trees had been taken out each year. It is a question whether the trouble is contagious, since young trees set out in the place of those removed do not seem to be especially troubled. The cause of the disease is not surely known. Most probably it is due to a fungus developing in the bark and wood, producing these abnormal and diseased conditions of the tissues. Sections of the cortex have shown the presence of mycelium in the diseased tissues, but it is possible that this may have come in late as a saprophyte. The other possible explanation is that the morbid conditions result from too great moisture in summer, followed by injury from severe cold in winter. Most growers remove the trees as soon as found since they never amount to much.

DEAD LIMB FUNGUS, *Cytospora Persicæ* Schw. This fungus, apparently, is never the cause of disease, but it is frequently present on the dead limbs as a saprophyte. Sometimes a dead tree is entirely covered with its outbreaks. These show as small white pustules.

LEAF BLIGHT, *Cercosporella Persica* Sacc. The name frosty mildew describes more aptly the appearance of the fungus. It produces yellowish or reddish areas on the leaves, showing the fruiting condition on the under surface usually as a conspicuous white growth. Thaxter, in the Report for 1889, p. 173, records the defoliation of orchard trees at Deep River by this fungus. The writer has observed it only once, where it was doing a little damage to nursery trees.

LEAF CURL, *Exoascus deformans* (Berk.) Fckl. Colortype 7. Leaf curl is one of the earliest appearing diseases of the peach, showing soon after the leaves come out. It kills the entire leaf, or the greater part of it, usually from the tip downward. The leaf turns yellowish or reddish brown, and becomes more or less irregularly curled or wrinkled. Often a whitish bloom is seen on the diseased area. The worst infected leaves drop off, so serious defoliation may often take place. The trouble may be prevented largely by a single spraying with Bordeaux mixture just before the buds begin to swell in the spring. In very wet seasons a second application, with the half strength mixture, should be applied just after the petals fall. The winter treatment with the lime, sulphur and salt for the scale is said to also check this trouble somewhat. [Bull. 142, p. 12.]

POWDERY MILDEW, *Sphaerotheca pannosa* (Wallr.) Lev. In nurseries where the trees are crowded closely together, this fungus is found sometimes causing trouble. Occasionally it is also found on trees in the orchard. The young leaves and the twigs become covered with an evident white felt of the mycelium and summer spore stage, but the winter stage has not been observed. Planting the trees less closely would no doubt be helpful in preventing the trouble or spraying with potassium sulphide should control it.

SCAB, *Cladosporium carpophilum* Thm. Plate XXI, a, c-d. This fungus occurs on the fruit, leaves and twigs. It forms the black, circular, superficial spots so commonly seen on the fruit in the market. Very frequently these scabby spots pretty thoroughly cover one half the surface, that which faced upwards on the tree. When abundantly attacking the young fruit, it may cause it to develop one-sided, or to crack open when mature, thus exposing it to decay by the brown rot fungus. On the leaves, the fungus produces a reddish brown spotting of the tissue, which later may drop out, giving a shot-hole effect. On the young twigs it also produces conspicuous reddish brown spots often with a purplish border. The mycelium lives over the winter on the infected twigs and produces the summer spores in the spring. The advantage of a winter or early spring treatment on the dormant tree is readily seen. Several Connecticut orchardists report less scab in their orchards after spraying with the lime, sulphur and salt mixture for the San José scale. The treatment for leaf curl should also be of benefit for this trouble. Winter treatment, however, will not wholly stop it. Taking into consideration the few peaches harvested last year, the scab was more injurious than usual. [Reps. 1894, p. 138; 1896, p. 269; 1898, p. 261; 1900, p. 232; Bull. 142, p. 12.]

Spray Injury. The experiments of Sturgis, Rep. 1900, p. 219, showed conclusively that there was danger in the use of fungicides on the mature foliage, at least in Connecticut. Bordeaux mixture, which is the fungicide commonly used, will produce a leaf-spotting and shot-hole effect very like that of the scab fungus. The worst injured leaves fall off, so it is possible to completely defoliate the tree. The writer found that there was even danger in the use of the half strength solution. Potassium sulphide, apparently, is the safest fungicide to use on the mature leaves.

Winter Injury. Plate X, a. The sudden freeze in December, 1902, killed the fruit buds very generally and also injured the wood slightly. This darkening of the wood often showed in spots in a cross section of the branch and became more evident toward the ends of the twigs, sometimes ending in a dead twig. The growth of new wood made the next year was good, though not so great where the injury was very manifest. The winter of 1903-4 was very much more injurious. While the trees went into the winter in better condition than the previous year, the continued and severely cold weather made its influence felt in a number of orchards. The injury to the fruit buds, apparently, was not so great as the year before. The chief injury was to the wood of the trees; this showed in the blackening or darkening of the wood clear down to the snow line. The few inches of the trunk next the ground, protected by the snow, appeared uninjured. As yet, the bark does not show the effect of this injury, and no cases of its girdling was observed, as with apples the previous year. Most orchards escaped this injury, while others in the same locality but lower down, were very severely injured. Many trees will no doubt have to be cut out; others may pull through with a severe pruning. What future troubles may result to trees severely injured, if left standing, is not known.

Yellows. This is now considered a physiological trouble, due to certain enzyms or ferments acting on the tissues and disarranging their normal functions. It is a contagious trouble. No doubt many sickly peach trees present symptoms that may be mistaken for yellows by some. The general characters of the disease are as follows: A premature ripening of the fruit, which becomes streaked with red and is of very poor quality; a premature development of the winter buds, giving rise to excessive branching on the new shoots; the development of adventitious buds into elongated sickly water sprouts; finally, a scantier and sickly yellowish development of the foliage. The usual method followed with this trouble is to grub out the trees as soon as discovered, and plant new ones in their places. [Rep. 1893, p. 92; Bull. 142, p. 137.]

PEAR, *Pirus communis.*

BITTER ROT, *Glomerella rufomaculans* (Berk.) Sp. & von. Schr. Occasionally found on this host but not very injurious. See Apple.

BLACK MOLD, *Fumago vagans* Pers. This fungus lives in the honey dew secreted by lice, and, while often forming a conspicuous coating on the leaves, it is hardly to be feared in itself. Last year the seasonal conditions were unusually favorable for the propagation of the pear psylla and the green apple louse, and these insects did serious damage to their hosts. Early in June, developing in the honey dew of these insects, there appeared on the pear and apple leaves and twigs a conspicuous coating of the black mold, which remained prominent during the season. Some growers mistook this for the cause of the injury, which really resulted from the attack of the lice.

BLACK ROT, *Sphæropsis Malorum* Pk. Occasionally occurs on twigs, fruit and leaves. See Apple.

Brown Rot, *Sclerotinia fructigena* (Pers.) Schrt. Not a very serious trouble on this host. See Peach.

Fire Blight, *Bacillus amylovorus* (Burr.) De Toni. This bacterial disease is the most serious enemy of the pear. It was with this that bacteria were first proved to be the agents of disease in plants. Insects visiting the blossoms accidentally carry the germs to the nectar, where by multiplication they gradually work down into the young twigs and cause their death in late spring or early summer. Blighted twigs, a foot or two in length, with the blackened, dead leaves still adhering, occur commonly. Cankered areas also occur in the bark of the older branches or the main trunk. Sometimes sticky exudations of the bacteria may be found on these diseased places, and are thus exposed to distribution by insects. Some growers believe that blight occurs more commonly on cultivated trees than those left in sod. The only treatment is thorough pruning. This should be done in winter, when the germs are less likely to be distributed, and care should be taken to cut off the limbs below the disease. The occasional dipping of the pruning knife into corrosive sublimate, to kill adhering germs, is also advocated. Cankered areas may be scraped and painted. Blight occurs also on the quince, apple and rarely on the plum. [Rep. 1894, p. 113; Bull. 142, p. 13.]

Leaf Blight, *Entomosporium maculatum* Lev. Sometimes this causes serious injury to the leaves and fruit. See Quince.

Leaf Spot, *Septoria piricola* Desm. So far, this has been found only sparingly here. The leaves become more or less covered with small, greyish, subcircular or angular spots with purplish borders. It may be prevented effectually by the usual treatment for pear scab. [Bull. 142, p. 13.]

Pink Mold, *Cephalothecium roseum* Cda. Occasionally causes rot in ripe stored pears. See Apple.

Rust, *Gymnosporangium globosum* Farl. Thaxter reported the æcidial stage of this rust [Rep. 1890, p. 98] on Japanese varieties, where it was doing considerable damage. See Apple.

Scab, *Venturia pirina* (Lib.) Aderh. Like apple scab, the parasitic summer stage (*Fusicladium pirinum*) of this fungus is now known to be connected with a saprophytic asco-spore stage that develops on fallen leaves. Pear scab is closely related to apple scab and very similar in appearance, and the treatment for its prevention is practically the same. See Apple. [Reps. 1889, p. 173; 1893, p. 73, 90; 1894, p. 135; Bull. 142, p. 13.]

Sooty Blotch, *? Phyllachora pomigena* (Schw.) Sacc. This is not nearly so troublesome on the pear as on the apple, *q. v.*

PEONY, *Pæonia* sps.

Scab, *Cladosporium Pæoniæ* Pass. This trouble forms very conspicuous blotches, often over an inch in diameter, on the leaves. Usually these start at the border and extend inward. They are purplish on the upper surface and reddish brown beneath. It was found once doing damage in a nursery.

PEPPERS, *Capsicum annuum.*

Anthracnose, *Colletotrichum nigrum* Ell. & Hals. In the Report for 1899, p. 282, Sturgis states that he found this fungus destroying 25 per cent. of the fruit in certain fields. It develops light brown, rotten areas on the fruit, which greatly enlarge and ruin the fruit. The fruiting stage shows on these rotten spots as numerous minute black pustules. Spraying experiments, conducted by Halsted, of New Jersey, did not prevent the disease very successfully. The rotten fruit, as soon as it appears, should be picked and carried away.

Anthracnose, *Glœosporium piperatum* Ell. & Ev. The writer has found this sparingly in the fields. It produces a rot of the fruit like the above, but the fruiting stage shows as minute pinkish globules.

Black Mold, *Macrosporium commune* Rabh. On the rotten areas of the fruit, one sometimes finds this fungus developing a luxuriant olive-black moldy growth. Apparently, it is only a saprophyte.

Grey Mold, *Botrytis* sp. The grey mold that affects a great variety of plants also produces rot on the peppers, and develops a dense, erect growth of the olive-grey fruiting threads on them in moist weather.

PHLOX, *Phlox* sps.

Leaf Blight, *Septoria* sp. Forms large, irregular, whitish areas in which are thickly embedded the small black spore receptacles.

LEAF SPOT, *Cercospora omphacodes* Ell. & Holw. Forms small whitish spots with purplish borders.

POWDERY MILDEW, *Erysiphe cichoracearum* DC. Plate XXIV, a. This is a common trouble with phlox, the mycelium thickly coating the stem and leaves. Both spore stages occur. The trouble could probably be kept in check by spraying.

PINK, SWEET WILLIAM, *Dianthus barbatus.*

STEM ROT, *Rhizoctonia* sp. See Platycodon.

PLATYCODON, *Platycodon grandiflorum.*

STEM ROT, *Rhizoctonia* sp. The stems gradually rot at the ground, and the plants wilt and often die as the result. The fungus lives in the soil and appears year after year, killing some of the stems. The trouble may spread to neighboring plants, as it occurs on Sweet William, mignonette, carnations, etc.

PLUM, *Prunus* sps.

BLACK KNOT, *Plowrightia morbosa* (Schw.) Sacc. Plate XXIV, c. The black, gall-like excrescences that occur on the limbs are familiar to every one. Ordinarily, they form an elongated irregular enlargement two or three times the thickness of the small branch. The surface is very uneven with minute elevations; indicating the spore cavities. The knots sometimes attain considerable size or produce distortion in the large branches. By the thorough pruning of affected branches, the trouble can be held in check. In the nursery this can be supplemented with spraying. The mycelium penetrates deeply into the wood and causes dark streaks; in pruning, all this should be removed. Where large branches are removed, it is best to paint over the cut surfaces. In some cases entire trees need to be cut down. The Japanese varieties now seem to knot as badly as any of the others. Wild and cultivated plums and wild cherries are subject to the same trouble. While always present, it seems to have developed more vigorously than usual during the past two years. [Reps. 1889, p. 176; 1893, p. 94; Bull. 142, p. 6.]

BROWN ROT, *Sclerotinia fructigena* (Pers.) Schrt. A serious trouble of this host. See Peach. [Rep. 1889, p. 176.]

CROWN GALL, *Dendrophagus blobosus* Toum. Plate XXIV, b. So far this has been found here chiefly in nurseries. The galls are usually on the lower part of the stem near the ground, or on the roots. They are morbid outgrowths of the tissues, usually subspherical in shape and about an inch or two in diameter. Sometimes they practically encircle the crown, girdling the tree. Professor Toumey made a study of this trouble on the almond in Arizona and ascribed it to a new species of slime mold. Nursery stock showing any signs of these galls should be rejected. The same trouble is found here in nurseries on the peach, and the same or similar troubles occur on raspberry and apple. [Bull. 142, p. 14.]

FIRE BLIGHT, *Bacillus amylovorus* (Burr.) DeToni. In the Report for 1894, p. 117, Sturgis described a bacterial trouble of plums found doing damage in an orchard at Hartford. It was not known at that time whether the trouble was the same as pear blight, but later study by Jones, of Vermont, seems to show the identity of the two.

LEAF CURL, *Exoascus mirabilis* Atk. Sturgis records this as doing damage in an orchard in New London in 1895. The trouble is somewhat similar to peach curl, except the young branch, as well as the leaves, becomes distorted into an irregularly thickened body. The injury to the leaves usually extends from the base up. The same treatment given for peach curl should be used for this.

LEAF SPOT, *Cylindrosporium Padi* Karst. This does not occur so commonly on the plum as on the cherry, *q. v.*

PLUM POCKET, *Exoascus Pruni* Fckl. So far this has not been recorded from this state, but is included here in the hope that some one will send in specimens. It is caused by one of the curl fungi, which attacks the young plums, forming elongated, inflated bodies.

POWDERY MILDEW, *Podosphæra oxyacanthæ* (DC.) DeBy. So far this mildew has been found only in its conidial form, producing whitish growth on the leaves. Apparently it is not common.

SCAB, *Cladosporium carpophilum* Thm. This has been found here only on wild plums, but no doubt it occurs occasionally on the cultivated sorts. See Peach.

Shot-hole. Spraying and certain fungi may produce shot-hole troubles in the foliage of plums, but in most of the cases examined these seemed to have had other agents; at least, the trees were not sprayed and no signs of a fungous agent were found. Insects are probably responsible in some cases, and it is barely possible that, as in the case of the peach, bacteria cause the trouble. Some botanists have attributed it at times to weather conditions. The plum seems to resent any injury to the foliage by dropping out the injured tissue.

POPLAR, *Populus* sps.

ANTHRACNOSE, *Marsonia Castagnei* (Desm. & Mont.) Sacc. The white poplar, *Populus alba,* is attacked by this fungus. It produces reddish brown, subcircular spots on the upper surface of the leaves; the spots may become so numerous that they merge into one another. The spores ooze out through very small rifts in these spots.

CANKER. Nurserymen complain of a trouble of the Carolina poplar that is apparently of fungous origin and produces cankered places in the bark and wood, especially at the base of the young branches.

RUST, *Melampsora populina* (Jacq.) Lev. This is a common trouble occurring on the leaves of a number of the poplars. The uredo-spores break out as dusty, reddish pustules, but the teleutospores are permanently embedded in the tissues and mature often after the leaves fall to the ground.

POTATO, *Solanum tuberosum.*

ANTHRACNOSE, *Vermicularia* sp. After potato vines die, especially if blighted, this common saprophytic fungus almost always appears on the stems, showing its fruiting stage in numerous, minute black tufts.

BLIGHT OR DOWNY MILDEW, *Phytophthora infestans* DeBy. Plates XXII, d, XXIII, a-b. Any dead potato vine is likely to be called blighted by the general observer. This trouble, however, does not appear, usually, until about the middle of July or later. Wet weather, of several days duration, any time from the first part of July till the middle of August is very likely to bring it into prominence, whole green fields suddenly turning brown, the vines dying in a few days. A careful examination of these fields, however, would show its presence, in an inconspicuous way, some time before this. At first, prominent black spots appear at the tips or margins of the leaves. Careful examination on the under side shows a slight whitish growth at the juncture of the green and diseased tissue. This is the summer spore stage of the fungus, and it is by the quick germination of the spores, in drops of moisture, that the disease rapidly spreads. The black spots soon envelop the whole leaflet, the leaves die, and soon there remain only the upright stems bearing the inconspicuous dried up foliage. The fungus occasionally appears on the green stems, but usually these die only as the result of the death of the leaves. The writer has rarely found the fungus on the tubers, but it apparently passes the winter in them, since the mature or oospore stage has never been surely found. The rotting of the tubers may or may not follow the blighting of the vines. This rotting, apparently, is due to other agents; namely, bacteria and the Fusarium fungus, *q. v.*

By thoroughly spraying the vines with Bordeaux mixture, the blight can be largely prevented, or so delayed that the yield of tubers is greatly increased over that of unsprayed fields. The writer has this subject under investigation to determine, if year after year, spraying potato fields in Connecticut is a paying operation. The results of two years work indicate that it is profitable when the work is done thoroughly and on time. In one case the sprayed rows gave twice the yield of those unsprayed; in another case the yield was a third greater; in a third case, where the vines were very imperfectly sprayed, the increase, if any, was lost through rotting. The first spraying should be given before the first appearance of the trouble, about the 7th to the 15th of July, according to the season; the second and the third should follow as the sediment wears off the leaves. If rightly placed, three sprayings will ordinarily suffice, but the vines should be well protected by the sediment until about the first of September. It is very important that the vines *be thoroughly covered with the spray when the blight weather comes on* and it is usually best to immediately follow this weather with another spraying. The best apparatus for spraying is a two-wheeled cart or light wagon that will straddle two rows, allowing the horse to walk between, and the common barrel spray pump mounted in it, having two leads of sixteen foot hose provided with double nozzles. One man drives and pumps, and two men follow behind the cart, each spraying three or four rows. The foliage should be well drenched with the mixture, using two or three barrels per acre. In the writer's experience, geared power sprayers are not satisfactory, since with these the foliage can not be properly covered with the spray. [Reps. 1889, p. 173, 176; 1890, p. 102; 1892, p. 39; 1893, p. 73, 100; Bull. 142, p. 15.]

DRY ROT, *Fusarium oxysporum* Schl. (*F. Solani* (Mart.) Sacc.) Plate XXII, b. Smith and Swingle, of the United States Department of Agriculture, have lately shown this fungus to be responsible for a wilt of vines, and for end rot and the bundle blackening of the tubers. During the past season, many vines wilted in this state before the middle of July. Possibly this was caused by the fungus described here. After the downy mildew killed the vines, there was general complaint of rotting tubers, and the dry rot fungus, unquestionably, was partially responsible for this. The rot did not do much damage until after the vines were blighted, for very few of the potatoes dug immediately after the vines blighted were rotted, while in adjacent rows, dug two weeks later, very many were rotten. There was a great difference in the amount of rot in different fields, and even in different parts of the same field. During the past winter, the market potatoes have shown an unusual amount of end rot and the bundle blackening. Sometimes, these potatoes appear perfectly sound on the outside. Usually the end rot begins at the stem end and gradually rots the tuber, often showing the fungus as a whitish mold on the outside. The potato shown in Plate XXII, b, was one taken from the field and placed for a day or two in a moist chamber to develop the growth of the mold on the outside, so it shows this more prominently. Care in selecting seed potatoes free from this trouble and spraying thoroughly for the blight are, perhaps, the best methods for lessening the trouble. Season, in some way, seems to be an important factor in determining the amount of rot, since in 1902 there was little of this trouble, while in 1903 it was very common, yet, both years the vines blighted. Apparently, wet weather, after the vines blight, develops the trouble most vigorously.

EARLY BLIGHT, *Alternaria Solani* (E. & M.) J. & Gr. This trouble produces distinct, subcircular, brown spots about one-fourth of an inch in diameter on the leaves. The spots often show faint concentric rings of development. Paris green may burn spots on the foliage so similar to these that the two injuries are not easily distinguished. So far as observed by the writer, this trouble has not proved very serious in this state. It usually appears early in the year, and is most common in moist seasons. The tomato and egg plant are also hosts for it.

ROSETTE, *Corticium vagum* var. *Solani* Burt. So far the writer has not found this doing serious damage in Connecticut, though it has been very injurious in several other states. The trouble appears early in the season, dwarfing the vines or causing the foliage to become crowded into rosette clusters. Badly infected vines may be killed outright. It is caused by the sterile mycelium (called *Rhizoctonia*) of this fungus, producing cankered or dead areas on the stems near the ground. The plants sometimes send out new roots above these girdled places; but the effect in any case is to produce a crop of small potatoes. Selection of good seed tubers followed with treatment in formalin will prevent the disease if the potatoes are planted in uninfected soil.

SCAB, *Oospora scabies* Thaxt. Plate XXII, c. Professor Thaxter, while botanist of this Station, first found the cause of the scabby or superficially corroded condition of potatoes so common everywhere. This is due to a fungus, which on freshly dug potatoes sometimes shows as a slight whitish mold on the scabby places. It is known that this fungus becomes established in the soil and the use of manure was shown by Sturgis to greatly increase the number of scabby tubers. Seed treatment with corrosive sublimate or formalin (see page 295 of this report for directions) will prevent the scab if the treated potatoes are planted on uninfected land. Beets, turnips, etc., are also subject to scab. [Reps. 1877, p. 68; 1886, p. 79; 1890, p. 81; 1891, p. 153; 1893, p. 102; 1894, p. 118; 1895, p. 166; 1896, p. 246; Bull. 103, p. 3; 142, p. 15.]

WET ROT, *Bacterial.* Plate XXII, a. During the past season this trouble, together with the dry rot fungus, caused serious rotting of the tubers. The bacterial rot can be told from the dry end rot by the slimy rotten condition of the tissues and the very strong odor. Sometimes the same tuber has both agents at work. The season early in 1903 was very unfavorable for potatoes. This was due to the very dry May, followed by a very wet June. In some fields, as a result of these conditions, a bacterial rot of the young stems developed, starting usually below the ground and coming possibly from the decayed tubers. It produced a black and often soft rot of the tissues of the stem and caused the wilting, yellowing or death of the parts above. This trouble was found worse in one field that had been planted to potatoes immediately after plowing under green rye. The stand obtained in this field was very irregular, and in the fall the tubers were found badly rotted from the bacterial wet rot. Very probably the bacterial troubles of the vines early in the season and of the tubers later were caused by the same organism, though no experiments were undertaken to prove this.

Paris Green Burn. Potato foliage is very often burned by the use of too much Paris green or by its use without lime to neutralize its caustic effects. The injury may occur as distinct roundish spots, or it may show as a general searing of the margins, which die and dry up.

Tip Burn. Dry warm weather of midsummer may cause many of the leaves to die at their margins, which become dry and rolled up, because the leaves are not able to check or replace sufficiently the water lost through transpiration. It is a trouble, however, that is more common and injurious in the drier states of the Mississippi valley.

PRIMROSE, *Primula* sp.

GREY MOLD, *Botrytis vulgaris* Fr. See Lettuce.

PRIVET, *Ligustrum Japonicum.*

Winter Injury. The freeze of December 9, 1902, seriously injured the California privet by killing the branches. Very few plants were killed outright, so that with vigorous pruning the injured spots in the hedges were gradually obliterated during the growing season.

PUMPKIN, *Cucurbita* sps.

POWDERY MILDEW, *Erysiphe cichoracearum* DC. The conidial stage of this fungus occurs as a scanty whitish growth, in patches on the upper surface of the leaves. Apparently, it does little injury. No doubt, most of the troubles recorded here under squash also occur on pumpkins but were not observed.

QUINCE, *Pirus Cydonia.*

BLACK ROT, *Sphæropsis Malorum* Pk. This often causes serious rotting of the fruit as it nears maturity, usually starting at the exposed blossom end. See Apple. [Reps. 1892, p. 43; 1893, p. 78; Bull. 142, p. 15.]

BROWN ROT, *Sclerotinia fructigena* (Pers.) Schrt. This is another fungus that produces rot in the ripening fruit, though it is not nearly so injurious to this host as to the peach, *q. v.*

FIRE BLIGHT, *Bacillus amylovorous* (Burr.) DeToni. Blight is very common on the quince. The leaves adhering to the dead twigs have a decided reddish brown color, quite different from the blackened leaves produced on the pear, *q. v.*

LEAF BLIGHT, *Entomosporium maculatum* Lev. So far the writer has observed this trouble only on the leaves and the fruit. It is one of the most common and serious troubles of this host. On the leaves it produces small, circular, brownish spots, often showing the fruiting body as a black dot in the center. When the leaves are badly infested, complete defoliation may result before the end of the season. On the fruit, the fungus produces a black spotting, and, especially with pears, may cause it to grow one-sided or crack open. Thaxter was one of the first to successfully prevent this trouble by spraying. Bordeaux mixture should be applied, first just before the blossoms open, again after they fall and a third and fourth time at intervals of about two or three weeks, according to the weather. [Reps. 1889, p. 173; 1890, p. 99; 1891, p. 150; 1892, p. 42; 1893, p. 89, 91; Bull. 142, p. 13, 15.]

LEAF SPOT, *Hendersonia Cydoniæ* Cke. & Ell. Occasionally this fungus occurs in spots on the leaves. Sometimes it may cause these, but often it merely develops on spots produced by the black rot fungus. [Rep. 1893, p. 81.]

RUSTS, *Gymnosporangium globosum* Farl., *G. nidus-avis* Thaxt., *G. clavipes* Cke. & Pk. The æcidial or cluster-cup stages of these rusts were reported by Thaxter and Sturgis on the leaves and fruit of quince. Sometimes they cause serious injury to this host. See Apple. [Reps. 1891, p. 161; 1894, p. 137.]

SCAB, *Fusicladium* sp. In the Report for 1893, p. 79, Sturgis records the occurrence of a destructive fungus, similar to apple scab, on the leaves of quinces at Tolland. The fungus was not specifically determined and has not been reported since.

RADISH, *Raphanus sativus.*

DOWNY MILDEW, *Peronospora parasitica* (Pers.) Tul. See Turnip.

LEAF MOLD, *Alternaria Brassicæ* var. *macrospora* Sacc. This forms numerous, small, blackish spots on the leaves and the diseased tissue sometimes drops out. The smallest spots look like insect punctures. See Cabbage.

WHITE RUST, *Albugo candidus* (Pers.) Ktze. The small, white blisters are formed on the under side of the leaves. Upon rupture of the covering epidermis the spores are gradually shed out as a dusty powder. While this fungus belongs with the downy mildews, its gross and microscopic characters are quite different, except with the winter spores. It probably occurs on a number of the other cultivated cruciferous plants. On wild pepper grass and shepherd's purse, the stems are often considerably distorted by its presence.

RASPBERRY, *Rubus* sps.

ANTHRACNOSE, *Glœosporium Venetum* Speg. Rarely this forms minute white spots on the leaves, but on the stems it occurs very commonly. Here it produces oval to circular white spots, often merging into one another, with purplish borders. It occurs most conspicuously on the new canes; on the old canes which carry it over the winter, the spots often become sunken and less prominently colored. So far only summer spores have been found. At pruning time the diseased canes should be cut out as thoroughly as possible; and after the disease has started on the new canes the worst of these might be taken out. In the spring before the buds swell, the canes should be sprayed with Bordeaux mixture; if repeated after the leaves develop, care should be taken to get it on the young canes chiefly. [Reps. 1889, p. 172; 1893, p. 98; 1899, p. 274; Bull. 142, p. 16.]

CANE BLIGHT, *Sphærella rubina* Pk. Plate XXIV, e. This blight is not uncommon and causes considerable injury in the writer's opinion. Apparently, it is most troublesome on the red varieties. In its early stage the trouble might be mistaken for a bacterial disease, so it is called blight. It first shows on the young canes early in July, usually at the lower nodes from which the leaves have fallen. It spreads downward from the base of the leaf, or its scar, as an elongated purple blotch, which shows very superficial injury to the bark. Rarely these blotches start away from the node. The blotches gradually appear at the higher nodes and slowly grow in size, sometimes completely surrounding the stem. In the fall the diseased stems turn whitish all over, and during the following winter the asco-spore receptacles appear as small black specks, thickly scattered over this whitened bark. The spores are matured by May and ready for the infection of the young canes. So far no summer spore stage has been found. The foliage of the infected canes is usually streaked with yellow and crinkled. The treatment described for anthracnose will apply here. [Bull. 142, p. 16.]

CROWN GALL, *? Dendrophagus globosus* Toum. Plate XXIV, d. It is uncertain, as yet, whether this is exactly the same as crown gall of plum or not. The raspberry often has distinct knots very similar to those of the plum and peach, but usually they extend in more or less merged excrescences along the stem for some distance. Care should be used not to get stock from a plantation containing the disease; and certainly no plant showing it should be set out. Affected canes, when discovered, should be removed. See Plum. [Bull. 142, p. 16.]

LEAF SPOT, *Septoria Rubi* West. Common on leaves; occurs on wild species, as *Rubus odoratus*, etc. See Blackberry.

ORANGE RUST, *Gymnoconia interstitialis* (Schl.) Lagerh. Common on leaves of cultivated and wild species. See Blackberry.

WILT, *Leptosphæria Coniothyrium* (Fckl.) Sacc. The summer stage (*Coniothyrium Fuckelii*) has been described by Stewart, of New York, as responsible for a serious cane blight of raspberries in that state. The fungus causes dead areas in the bark and wood, sometimes completely girdling the bark, so that the parts above wilt and finally die. The fungus is sometimes associated with the blight fungus and their fruiting pustules are not easily distinguished, except when the former have shed out the spores in a dusty brown coating. On old stems this summer spore stage is often associated with an asco-spore stage (*Leptosphæria*), which is believed to be merely another stage of the same fungus. Both stages have been found here, but as yet serious injury has not been traced directly to the parasitic one. There has, however, been called to the writer's attention a trouble of blackcaps that may be caused by it. The fruiting canes, about the time the fruit should begin to turn, suffer from a serious wilt that dries up the berries. Spraying experiments conducted by Stewart gave no beneficial results.

Yellows. Another trouble described by Stewart is the yellows, which, apparently, is not uncommon in this state. The foliage becomes crinkled and mottled with yellowish streaks, and the fruiting canes often die before the fruit matures. This seems to be a physiological trouble, possibly similar to the yellows of peach. Spraying, with Stewart, gave no benefit. The writer has found it worst on soil poor in nitrogen.

RED BUD, *Cercis Canadensis.*

LEAF SPOT, *Cercospora cercidicola* Ell. This is not uncommon in nurseries. The leaves develop conspicuous reddish brown or purplish, circular spots, one-quarter to three-quarters of an inch in diameter.

RED TOP, *Agrostis alba* var. *vulgaris.*

BLACK STEM RUST, *Puccinia graminis* Pers. Not uncommon. See Oats.

SMUT, *Ustilago striæformis* (West.) Niessl. The smut is found most commonly from May to July. It occurs on the leaves, forming dusty outbreaks of the spores in elongated lines. These often involve the whole blade, and the plants are more or less stunted in their growth. After the spores fall out, the foliage becomes more or less shredded. The fungus also occurs here on timothy.

RHUBARB, *Rheum Rhaponticum.*

LEAF SPOT, *Ascochyta* Rhei Ell. & Ev. Pie-plant leaves not uncommonly have brownish spots of varying size and shape. Very often these show no sign of the fruiting stage of a fungus. In some cases, however, this fungus has been found.

ROSE, *Rosa* sp.

LEAF BLOTCH, *Actinonema Rosæ* (Lib.) Fr. Plate XXV, c. Greenhouse growers report this trouble more serious on the hybrid tea roses, La France, Liberty, Meteor, than on the hybrid perpetual. One or several purplish spots appear on the leaflets. These sometimes attain half an inch in diameter. With a lens, the mycelium can be seen radiating out from the center on the upper surface of the spots. When badly infected, the leaves turn yellowish and drop off. The disease also occurs on the hardy outdoor roses. Some of the greenhouse men recommend the sulphur and oil paint on the heating pipes for this trouble. Spraying with potassium sulphide may also prove helpful. [Rep. 1893, p. 86; Bull. 142, p. 17.]

LEAF SPOT, *Cercospora rosicola* Pass. This is not nearly so common or injurious as the preceding. The spots are smaller, less than one-eighth of an inch usually, and often have a lighter center with a purplish border.

POWDERY MILDEWS, *Sphærotheca Humuli* (DC.) Burr., S. *pannosa* (Wallr.) Lev. Plate XXV, a. The former mildew is the common one seen in greenhouses. It forms a scattered, mealy, or cobweb-like growth over the surface of the leaves, causing them to become more or less crinkled. If badly infected, they may fall off. Only the conidial stage occurs. Tea roses are most likely to suffer; among those most seriously affected are Saffrano, Bon Silene, Bride, Bridesmaid, Niphetos, Pierpont Morgan, Goldengate. Greenhouse men try to avoid drafts and use care in watering to keep down this trouble. Sulphur is very commonly sprinkled on the leaves, and when the fires are started, sulphur and oil mixture is painted on the pipes. The second mildew given above has been collected but once, on an outdoor rambler rose. A thick felt of whitish mycelium develops on the branches and more sparingly on the leaves. The winter stage occurs imbedded in this. [Bull. 142, p. 17.]

RUST, *Phragmidium subcorticium* (Schrank) Wint. All three stages occur on this host, most frequently on the leaves. Sturgis notes injury to cultivated plants. [Report 1893, p. 86.]

RUTA-BAGA, *Brassica campestris.*

POWDERY MILDEW, *Erysiphe Polygoni* DC. Conidial stage only. See Turnip.

RYE, *Secale cereale.*

BLACK STEM RUST, *Puccinia graminis* Pers. Common on the stems. See Oats.

Ergot, *Claviceps purpurea* Tul. Plate XXV, b. This is commonly found in volunteer rye. The conspicuous sclerotia, or compacted masses of sterile mycelium, show as purplish horns extending from the floral parts of the spike. It is from these, after they have fallen to the ground and become buried, that the asco-spore stage develops the next year. Ergot is poisonous, and where abundant in grain, if eaten by cattle, may cause serious trouble. A number of other grasses have smaller sclerotia developing in their flower parts, probably, in most cases, a species different from this.

Orange Leaf Rust, *Puccinia rubigo-vera* (DC.) Wint. This is common on the leaves, forming spore pustules similar to those of the crown rust of oats, though the spores are very different. [Rep. 1890, p. 98.]

Smut, *Urocystis occulta* (Wallr.) Rabh. Thaxter reported this smut not uncommon, but not very injurious. The writer has found it once in very limited quantity. The black, dusty spore masses break out in lines, rather completely covering the inner surface of the leaf sheaths.

SALSIFY, *Tragopogon porrifolius.*

Powdery Mildew, *? Erysiphe cichoracearum* DC. Occasionally this forms an inconspicuous growth of the conidial stage on the leaves.

White Rust, *Albugo Tragopogonis* (Pers.) Gray. In one market garden near New Haven this was found doing some damage. The summer spores occur as white blisters on the leaves and on the rupture of the covering epidermis become scattered.

SNAPDRAGON, *Antirrhinum majus.*

Anthracnose, *Colletotrichum Antirrhini* Stew. In one instance this was found seriously injuring Snapdragons grown outdoors. The leaves and stems become rather abundantly covered with whitish spots, usually oval in shape and marked with a distinct purple border. Generally these are about one-fourth of an inch in diameter, but by merging, may form an extended area. Very small black dots in the center show the fruiting stage of this imperfect fungus. In the fall, all of the parts above ground should be cut off and the rubbish burned.

SOAPWORT, *Saponaria officinalis.*

LEAF MOLD, *Macrosporium Saponariæ* Pk. The fungus causes whitish or greyish leaf spots, a quarter of an inch or less in diameter. The fungus probably belongs under *Alternaria* rather than under *Macrosporium.*

SORGHUM, *Sorghum vulgare.*

GRAIN SMUT, *Sphacelotheca Sorghi* (Lk.) Clint. Usually each grain of the entire panicle is changed into a slightly elongated smutted body. The same smut occurs on broom corn, but neither of these hosts are grown commercially in this state. The trouble can be prevented by either the hot water or formalin treatment of the seed.

RED SPOT, *Colletotrichum lineola* Cda. The leaves become streaked with elongated bright red spots which run together. The fruiting stage shows on these as black pustules.

SPINACH, *Spinacia oleracea.*

ANTHRACNOSE, *Colletotrichum Spinaciæ* Ell. & Hals. Possibly this may occur more abundantly, but so far only a few specimens have been found. It forms greyish elliptical to circular spots, a quarter of an inch in diameter, on the leaves.

SPIRÆA, *Spiræa Ulmariæ.*

LEAF SPOT, *Septoria Ulmariæ* Oud. Rather injurious to the foliage.

SQUASH, *Cucurbita* sps.

ANTHRACNOSE, *Colletotrichum Lagenarium* (Pass.) Ell. & Hals. On ripe or stored squashes this is not uncommon, and, possibly, it may also cause injury earlier in the season. The depressed, rotten areas may attain considerable size, and usually show the pinkish fruiting pustules. The fungus often opens the way for a general rot by other fungi and bacteria. See Watermelon.

BLACK MOLD, *Rhizopus nigricans* Ehr. Plate XXVI, b. This is a common mold on rotting fruit and vegetables. It occurs, sometimes with the next fungus, on the fading flowers of the summer squash, and in some cases is responsible for a rot of the fruit. See Sweet Potato.

Metallic Mold, *Choanephora cucurbitarum* (B. & R.) Thaxt. Plate XXVI, c. Very often the black mold described above occurs with this on the faded flowers, but the former can be told with a lens by its shorter threads, bearing firmer, spherical spore heads. This latter fungus is also easily distinguished by the metallic luster of the threads and the more loosely compacted heads. It, no doubt, often blasts the blossoms and may rot the young fruit also.

Powdery Mildew, *Erysiphe cichoracearum* DC. Conidia only. See Pumpkin.

Wilt, *Bacillus tracheiphilus* Sm. Plate XXVI, a. In this disease, bacteria clog the ducts of the stem or leaf petioles, so that the water supply is largely cut off from the parts beyond, and these wilt and eventually die. Cutting across the stems, one can often squeeze out these organisms in a slight, viscid, milky exudation. Apparently, insects distribute these germs and perhaps produce the disease through punctures in the leaves or by eating holes in them. Very often, diseased leaves are found where the trouble has run down the petiole and in some cases extended into the stem. The tissues of the leaf are more likely to show a diseased condition than are the vascular bundles in the stem. Spraying does not seem to lessen this trouble. The wilted vines should be removed and care taken to keep down the insects. Summer and Hubbard squash, also musk melons and cucumbers, are subjected to this wilt, which last year was more common than usual.

STRAWBERRY, *Fragaria* sps.

Fruit Rot, *Botrytis vulgaris* Fr. When the writer first came to the Station in July, 1902, he found some strawberries that had recently been sent in for examination, because they were rotting badly on the vines. The common grey mold was abundant on these and has since been seen occasionally in the field. Last year some growers complained of a rot trouble of the ripening fruit, which was probably caused by this fungus. Apparently, the crop often suffers during wet weather at harvest time from this rot. When it is likely to prove serious, the writer should judge that it could be minimized by carefully gathering the rotten fruit at each picking.

LEAF BLOTCH, *Ascochyta Fragariæ* Sacc. This is not so common, and consequently not so injurious as the next trouble, though occasionally it is found doing considerable damage. The two are very similar in appearance, but with this one the purplish blotches are larger, often merged, producing a general browning of the margins of the leaves.

LEAF SPOT, *Sphærella Fragariæ* (Tul.) Sacc. Plate XXV, d. The spots on the leaflets are usually distinct, circular, and possess a prominent purple border and a whitish center. The imperfect or summer stage is parasitic, while the winter or ascospore stage develops on the old dead leaves. The destruction of these leaves is therefore helpful in keeping the trouble in check. Some growers mulch the beds with salt hay and then burn them over in the spring, thus destroying the old leaves. Others advocate the very frequent renewal of the beds, as the trouble becomes worst in old beds. Spraying with Bordeaux has also been found useful. One treatment is given before blossoming, another after most of the petals fall, and a third and perhaps fourth after the picking season.

Frosty Spots. Last fall some of the growers near New Haven complained of a new leaf trouble that resembled mildew. An examination of the leaves, however, showed that the whitish spots were not due to any fungus but resulted from the flaking away of the cuticle. Later, the whitish appearance gave place to dead brown spots. Evidently, the trouble was a physiological one that had resulted in the flaking up of the cuticle and the collapse of the epidermal cells. This was, apparently, not due to frost, since it appeared chiefly before the first frosts. It was worst on plants set out between rows of early potatoes, and probably this treatment, with the unusually moist season, prevented the proper transpiration of water, which produced the injury through rupture of the cells.

SUNFLOWER, *Helianthus annuus.*

LEAF SPOT, *Septoria Helianthi* Ell. & Kell. Produces subcircular or irregular brownish spots from which the tissue sometimes drops out.

RUST, *Puccinia Helianthi* Schw. The uredo- and teleutospores break out on either side of the leaves, but more abundantly below, in numerous reddish dusty pustules, about the size of a pencil point.

SWEET POTATO, *Ipomœa Batatas.*

BLACK MOLD, *Rhizopus nigricans* Ehrb. This produces a soft rot of the roots. The grocer and the housewife very often find it difficult to keep potatoes because of its attacks. Where the skin is broken, the fungus develops its fruiting stage as a dense growth of blackish threads, ending in the small spore capsules.

SWEET VERNAL GRASS, *Anthoxanthum odoratum.*

SMUT, *Tilletia Anthoxanthi* Blytt. This changes the seed into an inconspicuous smutted body. The smutted spikes are about like the healthy in appearance, so the fungus is easily overlooked. The only time it has been collected in the United States was by the writer near New Haven in July, 1902.

SYCAMORE, *Platanus occidentalis.*

ANTHRACNOSE, *Glœosporium nervisequum* (Fckl.) Sacc. The leaves with this trouble develop brown, dead areas of varying shape and size, often running along the ribs. The disease may become so serious that defoliation takes place. The young branches, also, are said to be attacked. It is one of the worst troubles of the sycamore in this state.

TEOSINTE, *Euchlæna luxurians.*

SMUT, *Ustilago Zeæ* (Beckm.) Ung. See Corn.

TIMOTHY, *Phleum pratense.*

ERGOT, *Claviceps* sp. Small slender sclerotia are occasionally found in the spikes.

SMUT, *Ustilago striæformis* (West.) Niessl. On leaves. See Red Top.

TOADFLAX, *Linaria vulgaris.*

White Smut, *Entyloma Linariæ* Schrt. The fungus produces small, whitish, circular areas on the leaves and stem in which the spores are permanently embedded.

TOBACCO, *Nicotiana Tabacum.*

Frost Fungus, *Botryosporium pulchrum* Cda. (*Botrytis longibrachiata*). According to Sturgis, this fungus sometimes produces a stem rot in the tobacco while hanging in the barns during the later stages of curing. He says: "Stems affected with this disease are covered with pure white patches having the appearance of a long pile velvet. These patches spread rapidly, encroaching upon the veins of the leaf and destroying the tissue and in the end inducing a more or less widespread decay, especially in the neighborhood of the midrib and veins. It is not unusual upon entering a barn, even during the process of curing, to find the floor partially covered with the refuse of the previous year's crop, the latter often looking as though a fall of snow had whitened it, so densely is it covered with the mycelium and spores of this fungus. The slightest current of air serves to separate the spores from their attachment and carry them through the barn, some finding lodgment upon and at once infecting the curing stems and leaves." This fungus is common in greenhouses upon decaying stems, especially tobacco stems, left on the moist earth. Under certain conditions it may act as a parasite. See Vinca. [Reps. 1891, p. 184; 1893, p. 84.]

Seed Bed Rot (*Fungus*). The young tobacco plants sometimes dampen off in the seed bed apparently through the action of some fungus. This trouble has not been thoroughly studied yet. Care in the kind of soil used and in the regulation of temperature and moisture in the beds, should help to check a trouble of this kind.

Pole Burn (*Fungi and Bacteria*). Sturgis also made a special study of this trouble, which sometimes seriously affects tobacco while drying in the barns, especially when the weather is moist and warm and the barns can not be ventilated properly. He says of it: "At first the disease is limited to the neighborhood of the veins and midrib of the leaf where moisture is superabundant, but its spread is very rapid, the small blackened areas increase in size, become confluent and sometimes within thirty-six, or at most forty-eight hours, not only is the whole leaf affected but the entire contents of the curing barn may be rendered quite worthless as tobacco. Examination shows that the leaves have changed from greenish yellow to a dark brown or almost black color, that the fine texture has disappeared, and that instead of being tough and elastic, the whole leaf is wet and soggy, and tears almost with a touch, falling of its own weight from the stalk." Sturgis found this rotting was due to various bacteria and fungi. Regarding prevention, he states: "We have seen that whatever is the primary cause of pole burn, its ill effects can be in a large measure, if not entirely, prevented by a proper regulation of moisture and temperature." [Reps. 1891, p. 168; 1899, p. 265.]

Calico or Mosaic Disease. This is a trouble met in the growing fields of tobacco. The affected plants are usually somewhat stunted in growth, and the leaves have a pale greenish or later a peculiar yellow mottling, due to changes in the chlorophyll of the tissues. Usually these yellow streaks or areas follow the bundles and are separated by the normal green tissue. The trouble eventually renders the plants of little commercial value. Most growers pull up the diseased plants as they find them in the field, for their presence in the cured crop would only detract from its value. The trouble is considered a physiological one, rather than due to fungi or bacteria, and in nature approaches the yellows of peach. Certain unfavorable conditions in setting the plants or of the soil or moisture conditions are said to produce the trouble. As yet, however, too little is known of all the circumstances that contribute to this trouble and how to avoid it. [Reps. 1898, p. 242; 1899, p. 252.]

Rust. The cause of the irregular, usually small, spots appearing on the leaves in the field and called "rust" by the growers, is not known. Possibly it is also a physiological trouble. [Rep. 1899, p. 255.]

Spot. The writer has found in tobacco grown under cloth, circular, brown spots, about one-quarter of an inch in diameter, on the leaves. These were not uncommon in one field and had the appearance of the spot produced by the Alternaria fungus on potato, etc. They showed the usual faint concentric rings of development, but no signs of any fungus were discovered. This is probably the same thing described by Sturgis, Rep. 1898, p. 254, on tobacco grown in the open. He assigned no cause. Its presence, in moderate amount, is not generally regarded as a damage to the crop.

TOMATO, *Lycopersicum esculentum.*

ANTHRACNOSE, *Colletotrichum phomoides* (Sacc.) Chest. Plate XXVIII, b. This was found in a few fields on the ripening fruit, producing conspicuous sunken areas, in the center of which numerous closely clustered spore pustules occurred. Evidently it is a trouble that some seasons may produce serious injury at the ripening period.

BLIGHT, *Bacillus Solanacearum* Sm. Plate XXVII, a-c. The southern tomato blight was found, apparently for the first time, in the vicinity of New Haven last season. While noticed in several fields, it was only in the field of Mr. Andrew Ure, described here, that it was found especially injurious. A general view of the affected part of this field is shown in Plate XXVII. It was peculiar in that four rows straight through the field were very badly infected, many of the plants dying; the bordering rows were less seriously affected, while the remainder of the field away from these was practically free from the disease. So far as could be learned, there was no difference in the field or the treatment that could have produced this. The only way the writer could explain it was that possibly a certain block of the plants in one of the seed beds had contracted the disease and had been set out together in the field. Many of the plants had been killed before they showed any considerable growth in the field. Others less seriously infected were somewhat smaller than the healthy plants and showed diseased leaves here and there. The leaves on any part of the plant were affected, sometimes first turning yellow, but usually soon dying outright. Very often the leaflets and most of the petiole were brown and dead, while the lower part of the petiole for an inch or two was still alive and green. Cutting across the green stems or petioles, the trouble showed as diseased brownish spots, or as a complete ring in the bundles, which are situated between the pith and the bark. In severe cases there was also a lesion of the tissues in this vicinity. See Plate XXVII, c. In very advanced stages the base of the stems showed a general soft rot. Sometimes the leaves showed dead areas around the bundles and examination of the ducts showed these choked with bacteria. It was not determined if this was caused by the same bacterial agents that produced disease in the potatoes this same year; there is a possibility that it was. The potato bug and other insects probably carry this disease after it gets started in a field. It should be noted in this case, however, that the disease, apparently, did not spread through the field, neither were the potato bugs, etc., numerous last year.

Downy Mildew, *Phytophthora infestans* DeBy. Thaxter collected this fungus on the tomato where it was doing damage; but apparently, its occurrence on this host is comparatively rare. See Potato. [Reps. 1890, p. 95; 1893, p. 103.]

Fruit Mold, *Macrosporium Tomato* Cke. Very commonly, this forms a dense, olive-black, moldy growth on the point rot of the fruit and formerly was thought to be the cause of this trouble, but now it is considered only a saprophyte. See Point Rot.

Leaf Mold, *Alternaria Solani* (E. & M.) J. & G. Occurs not uncommonly on the leaves, occasionally doing damage. Often it is associated with the next trouble and may be mistaken for it. See Early Blight of Potato.

Leaf Spot, *Septoria Lycopersici* Speg. This is one of the most serious troubles of the tomato and has come into prominence during recent years. The leaves, stem and, rarely, the green fruit, may be attacked. The trouble is most injurious to the leaves, which become thickly covered with small, angular spots, usually having a greyish center and a deeper colored border. Apparently, it rarely matures on the small black specks it may produce on the fruit. Very probably it passes the winter through the summer spores formed in the fruiting receptacles on the stems, since no winter spore stage has been associated as yet with it. The trouble may be prevented largely by spraying with Bordeaux. The first spraying should be given a couple of weeks after transplanting, and two or three additional sprayings should follow each other at intervals of about three weeks. [Bull. 142, p. 18.]

SCAB, *Cladosporium fulvum* Cke. This fungus forms dense olive-brown growths in areas of varying size, on the under surface of the leaves, and often produces discoloration of the tissues on the upper surface. It is a trouble that occurs both in the field and greenhouse and sometimes does considerable injury. Spraying with Bordeaux, if taken in time, will prevent it. In the greenhouse care should be used in sprinkling water on the foliage, and the vines should not be planted too closely. [Reps. 1889, p. 173; 1890, p. 95; 1893, p. 102; Bulls. 111, p. 15; 115, p. 16.]

SLEEPING DISEASE OR WILT, *Fusarium Lycopersici* Sacc. In the Experiment Station greenhouse, for several years past, this trouble has appeared with increasing severity. As the seed has been selected each year from these plants, possibly this explains in part the severity of the trouble. It does not usually show until the plants have attained full size and are beginning to blossom abundantly. At first, a lower leaf or two will wilt, turn yellow and finally die. Gradually, the disease works up, successive leaves dying and drying up on the vine. At the time the plants come into bearing, the trouble usually shows prominently. Cutting across the green stem or petioles at the base of the plant, the disease first shows a discoloration in the vicinity of the bundles. Very often three diseased spots show in these cross sections. If the fibro-vascular bundles are examined in cross section under the microscope, they are found to be more or less filled with the mycelium of the fungus. This choking up of the vessels, with their later diseased condition, prevents the proper amount of moisture being carried up the plants, which in time suffer severely because of this. As the leaves die, the fungus may work to the surface from the vicinity of the petiole, producing dead areas on the stem which eventually show abundance of the whitish mycelium. The spores are formed abundantly on this, and it then assumes a pinkish color from their presence. Eventually, the whole plant dies and dries up, the stem becoming more or less completely covered with the pinkish, moldy growth. Very often this pink mold may show on the ripe fruit, especially at the base, developing out on it from the petiole. The disease is unquestionably carried in the soil and possibly also by the mycelium developing up the petioles into the seed. In cutting across green fruit, one occasionally finds that the disease has penetrated partially into it, and in this way may finally reach up into the seed. Where the trouble is established in a greenhouse, sterilization of the soil and treatment of the seed with hot water will apparently stop the trouble, if done thoroughly. Perhaps it would be best merely to sterilize the soil and get seed from an uninfected source.

Point Rot. Plate XXVIII, a. Apparently, the point rots of the greenhouse and the field are the same trouble. It usually first shows on the green fruit as a sunken, brown, rotted spot at the blossom end. This gradually enlarges, and later often becomes more or less covered with mold, especially the black mold. As yet, the cause of point rot is not surely known—it may be a bacterial trouble or it may be a physiological one. Selby, of Ohio, states that sub-irrigation in the greenhouse will largely prevent it. Spraying has not given very encouraging results.

TULIP TREE, *Liriodendron Tulipifera.*

Powdery Mildew, *Erysiphe Liriodendri* Schw. Forms a rather inconspicuous cobweb-like growth on the leaves. The asco-spore stage is not produced very abundantly.

TURNIP, *Brassica* sps.

Club Root, *Plasmodiophora Brassicæ* Wor. See Cabbage.

Downy Mildew, *Peronospora parasitica* (Pers.) Tul. Plate XXVIII, c. The fungus forms whitish tufts of the summer spore stage in patches on the lower surface of the leaves and produces discoloration of the tissues above. It occurs rather commonly in the fall in turnip (*Brassica Rapa*) fields and has also been found on the radish.

Powdery Mildew, *Erysiphe Polygoni* DC. The conidial stage only occurs on the upper surface of the leaves (*Brassica campestris*), producing the usual whitish powdery growth.

SCAB, *Oospora scabies* Thaxt. Observed by Sturgis on roots of both *Brassica campestris* and *B. Rapa.* See Potato. [Reps. 1894, p. 126; 1896, p. 266.]

VINCA, *Vinca major.*

FROST FUNGUS, *Botryosporium pulchrum* Cda. Ordinarily this fungus occurs as a saprophyte on dead stems lying on the moist ground, but on the Vinca it acted as a parasite. However, the varigated vinca plants were in pots placed temporarily under the greenhouse benches, where the water dropped down from above, so the conditions were favorable for the fungus, but not for the plants. The plants became so abundantly infested with the fungus that they were all killed. The luxuriant, white growth resembles somewhat the very heavy hoar frost that sometimes covers sticks on the ground. Examining it carefully with a hand lens, the erect threads, about one-quarter of an inch high, are seen to be provided with diverging side branches upon which are clustered the spores, the whole having a feathery aspect. See Tobacco.

VIOLET, *Viola odorata.*

ANTHRACNOSE, *Colletotrichum Violæ-tricoloris* Sm. Occurs occasionally on the leaves.

LEAF BLIGHT, *Cercospora Violæ* Sacc. Apparently occurs only occasionally, the spot disease being the common trouble.

LEAF SPOT, *Phyllosticta Violæ* Desm. Another occasional trouble. [Rep. 1891, p. 166.] These three leaf fungi are very similar in appearance, producing whitish or greyish spots.

ROOT ROT, *Thielavia basicola* Zopf. Reported by Thaxter in Rep. 1891, p. 166.

SPOT DISEASE, *Alternaria Violæ* Gall. & Dor. Plate XXVIII, d. This seems to be the chief trouble with greenhouse violets in this state. The white spots are circular, usually about one-eighth of an inch in diameter. They seem to start as black specks; and on the stem this blackening is most pronounced. It is only rarely that the writer has found the *Alternaria* producing spores on these spots, which seems strange since the disease often spreads rapidly in the beds. The trouble is likely to get started in the houses in the fall before heat is turned on, especially if the grower is trying to cut down his coal bill. The character of the house, as to moisture, soil, etc., probably also plays a prominent part in the trouble. The disease is very often worst where violets have been grown for some time. Growers generally pick off the diseased leaves as soon as they appear; in bad cases, however, this often means very severe pruning. Possibly the thorough removal of all diseased leaves when the plants are set out, followed with a treatment with Bordeaux mixture, might prove helpful in preventing the trouble. After the disease is thoroughly started, perhaps little can be expected from spraying. [Bull. 142, p. 18.]

VIRGINIA CREEPER, *Ampelopsis quinquefolia.*

LEAF SPOT, *Phyllosticta Labruscæ* Thm. On the leaves only. See Grape.

POWDERY MILDEW, *Uncinula necator* (Schw.) Burr. See Grape.

WALNUT, *Juglans nigra.*

ANTHRACNOSE, *Marsonia Juglandis* (Lib.) Sacc. Produces subcircular, usually dark reddish brown, spots or blotches on the leaves.

WATERCRESS, *Nasturtium officinale.*

LEAF SPOT, *Cercospora Nasturtii* Pass. Produces roundish light colored spots on the foliage, thus rendering it inferior for decorative purposes.

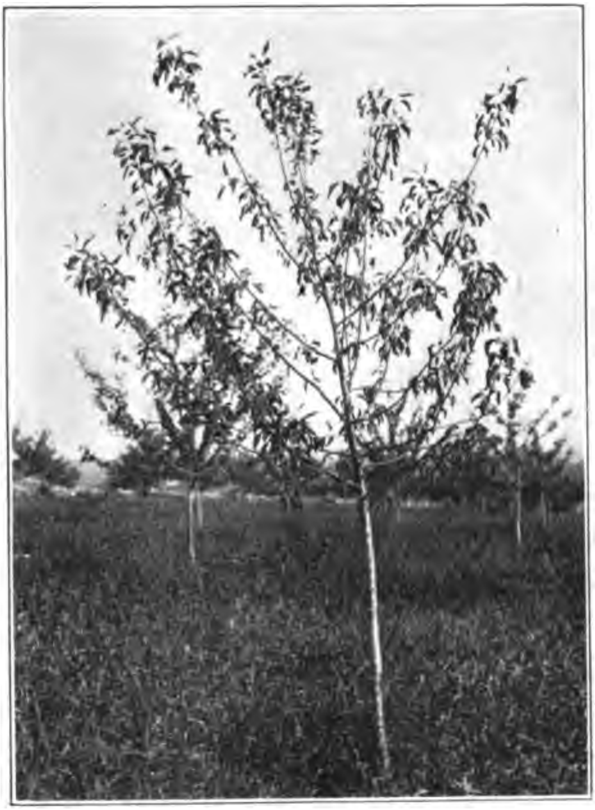
WATERMELON, *Citrullus vulgaris.*

ANTHRACNOSE, *Colletotrichum Lagenarium* (Pass.) Ell. & Hals. Plate XXVIII, e. This fungus occurs on both the fruit and the leaves. On the former it produces sunken, rotted areas, at first small, but increasing in size and number, usually until the melon is worthless. On these areas, the spores ooze out in viscid, pinkish masses; sometimes they may germinate in position, giving rise to a superficial growth of white mycelium, as shown in the plate. Either green or ripe fruit may be attacked. On the leaves, the fungus causes dead brown areas, upon which the exudation of spores may not be very conspicuous. This same fungus occurs on cucumbers, musk melons and squash. In the fall, the old vines and rotted fruit should be gathered from the field and burned, as they help to carry the trouble in the soil. Spraying with Bordeaux should begin when the vines start to run, and these should be kept covered during the season. [Bull. 142, p. 7.]

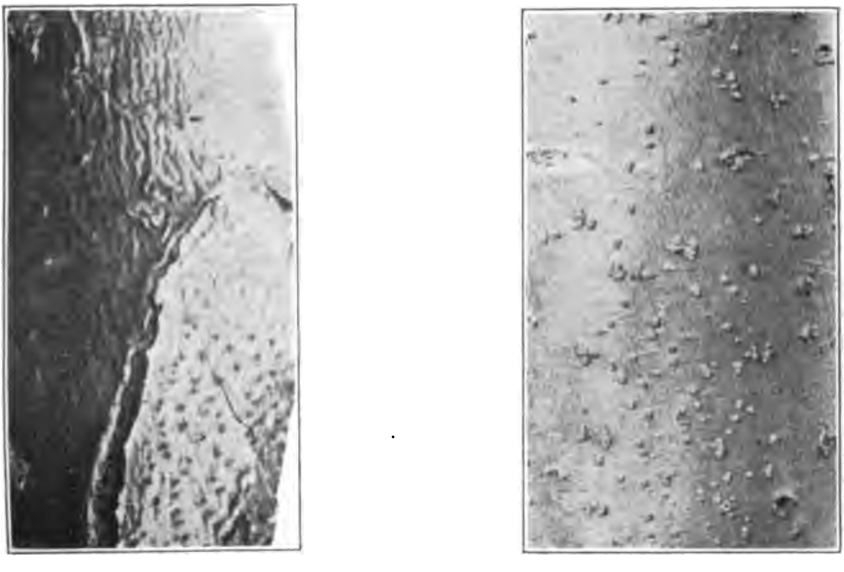
DOWNY MILDEW, *Plasmopara Cubensis* (B. & C.) Humph. So far as observed, this has not proved serious on this host. The fruiting threads are produced so meagerly on the under surface, that usually they can not be detected by a hand lens. See Musk Melon.

LEAF MOLD, *Alternaria Brassicæ* var. *nigrescens* Pegl. See Musk Melon.

PLATE IX.



a. Young tree with injured bark at base dropping its leaves in July, p. 303.



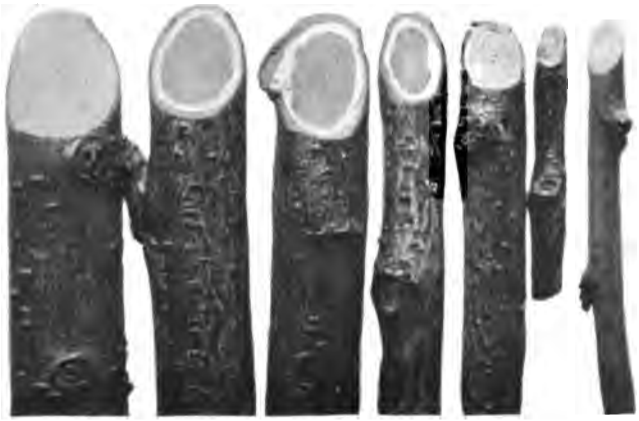
b. Injured bark studded with fungous growth. × 2.

c. Healthy bark showing lenticels.

WINTER INJURY TO BARK OF APPLE.

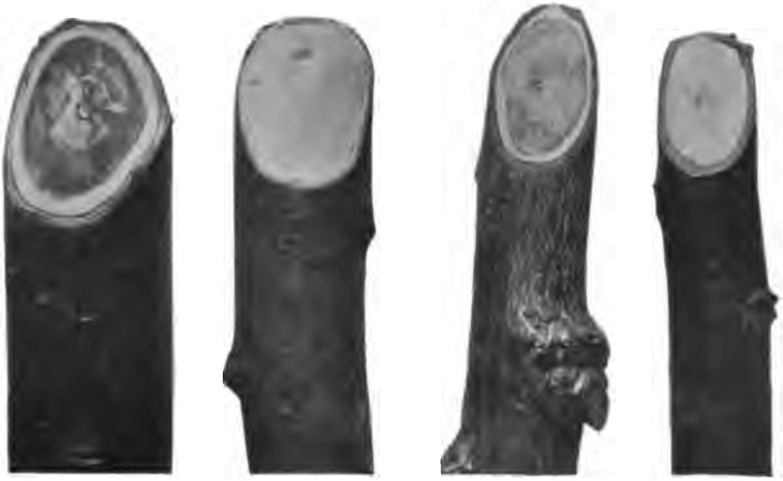
PLATE X.

a. Peach, p. 341.



Healthy. Injured. Healthy.

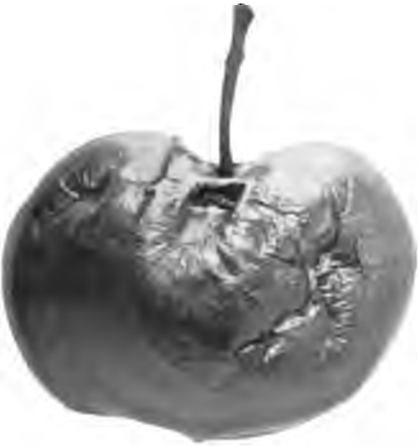
b. Apple, p. 303. c. Plum, p. 345.



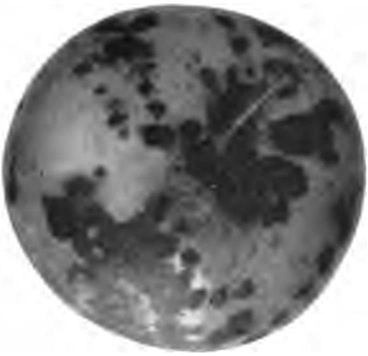
Injured. Healthy. Injured. Healthy.

WINTER INJURY TO WOOD OF FRUIT TREES.

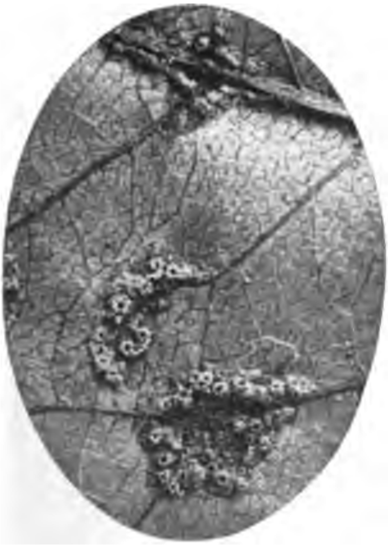
PLATE XI.



a. Black Rot, p. 298.

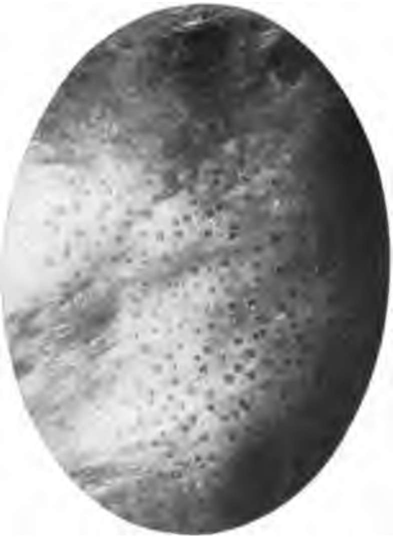


b. Sooty Blotch, p. 302



× 3

c. Cluster Cup of Rust, p. 301.

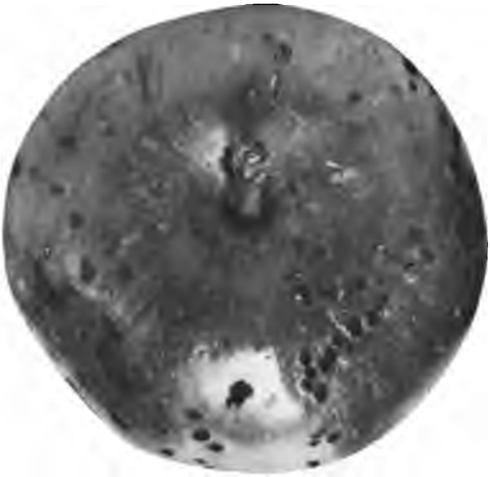


× 2

d. Fly Speck, p. 299.

FUNGI OF THE APPLE.

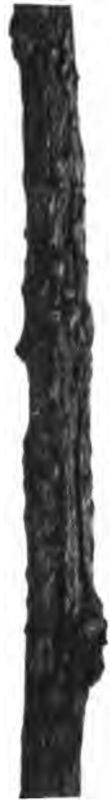
PLATE XII.



a. On fruit.

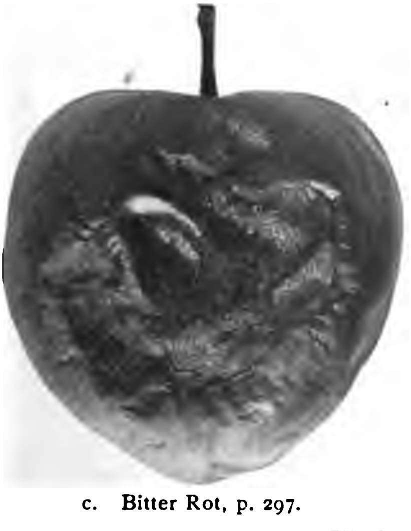
Scab, p. 301.

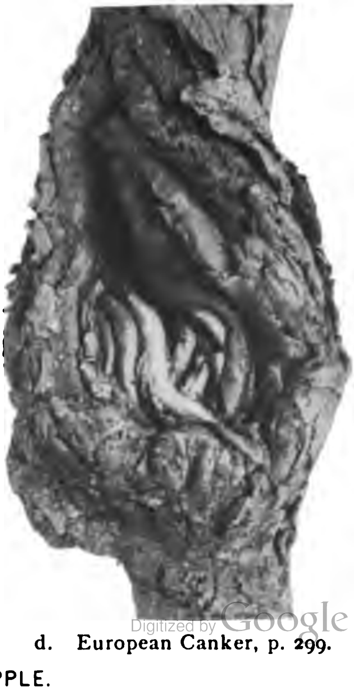
× 2.



b. On twig.

+ ½





c. Bitter Rot, p. 297.

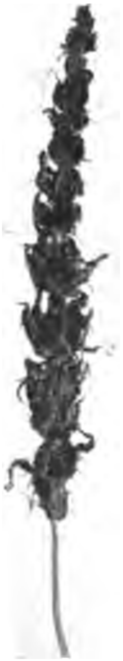
d. European Canker, p. 299.

FUNGI OF THE APPLE.

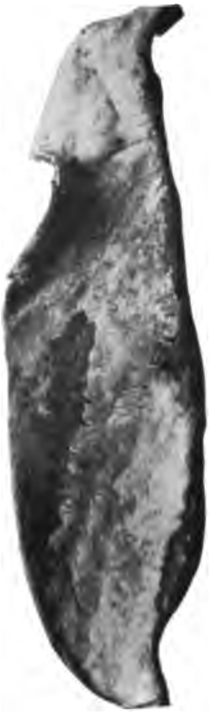
PLATE XIII.

Barley.

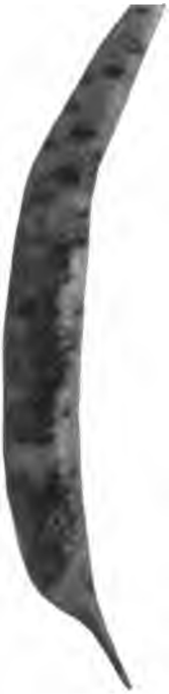
Bean.



a. Smut, p. 306.



b. Downy Mildew, p. 307.

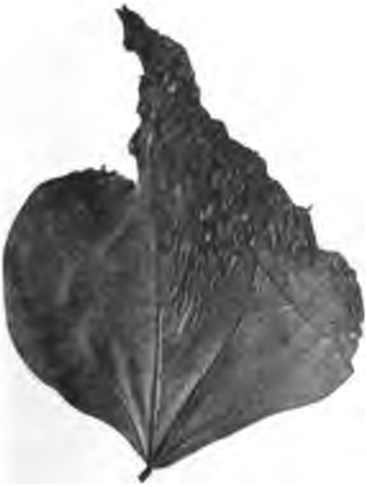


c. Anthracnose, p. 307.

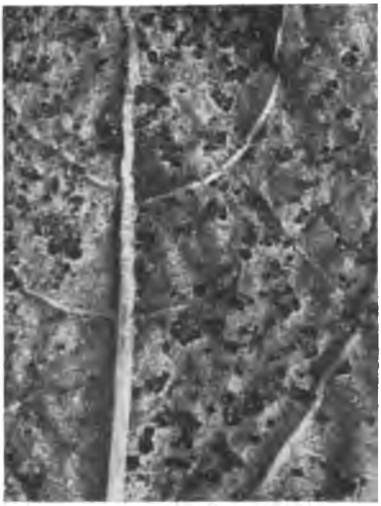
÷ ½.

Bean.

× 2.



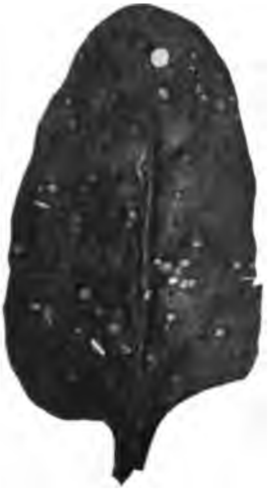
d. Blight, p. 307.



e. Rust, p. 308.

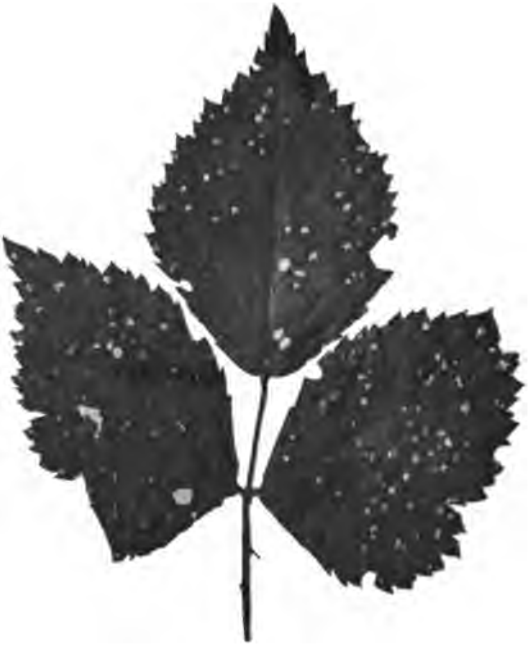
FUNGI OF BARLEY AND BEAN.

Beet ÷ ½.



a. Leaf Spot, p. 309.

Blackberry.



b. Leaf Spot, p. 309.

Blackberry.

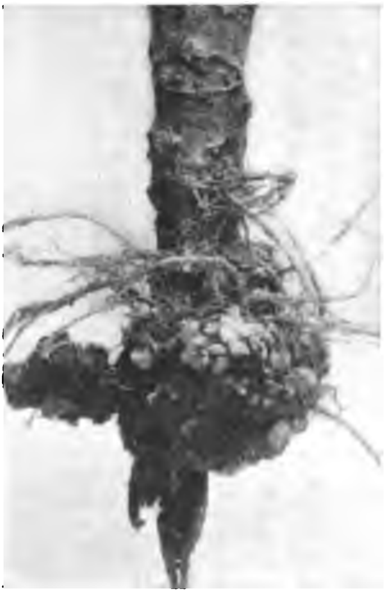
c. Rust, p. 309.

Buckwheat.

d. Leaf Blight, p. 310.

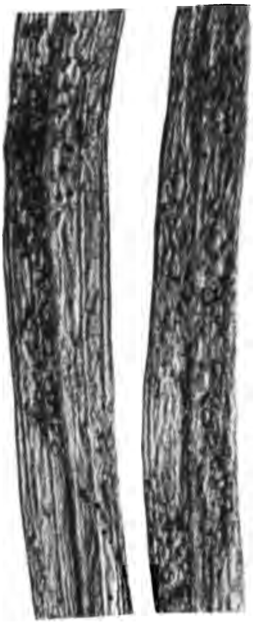
FUNGI OF BEET, BLACKBERRY, BUCKWHEAT.

Cabbage.



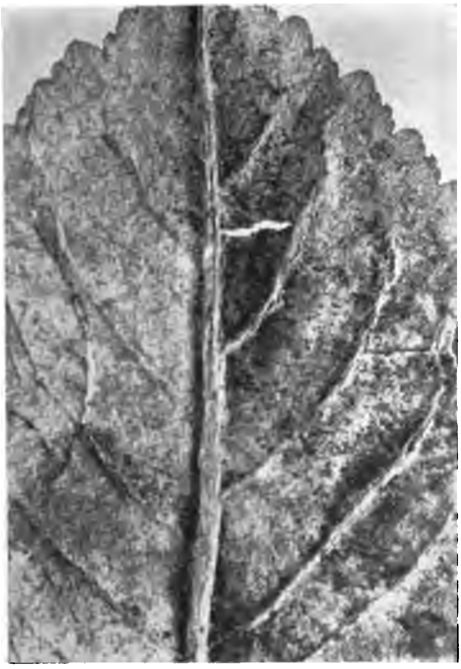
a. Club Root, p. 310.

Carnation.



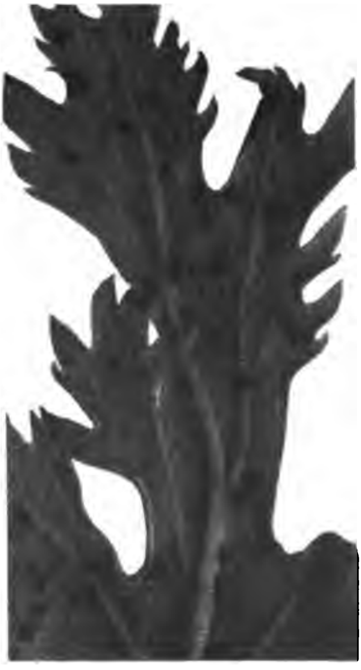
b. Rust, p. 312.

Cherry × 2.



c. Powder Mildew, p. 314.

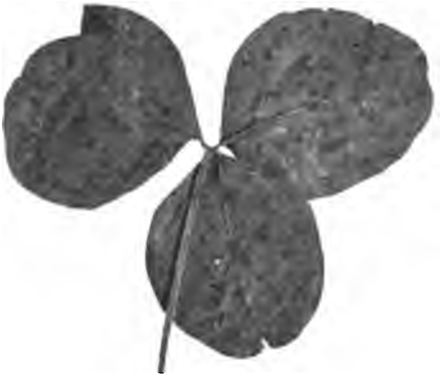
Chrysanthemum × 2.



d. Rust, p. 315.

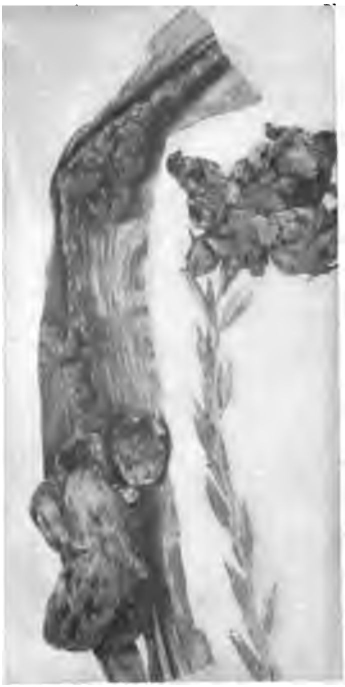
FUNGI OF CABBAGE, CARNATION, CHERRY, CHRYSANTHEMUM.

Clover.



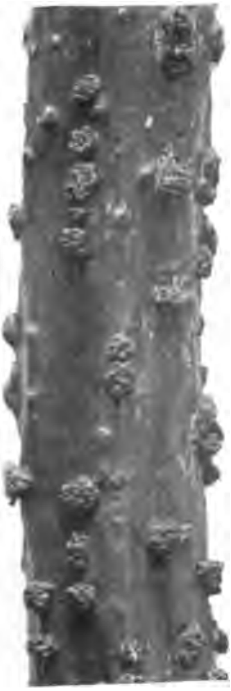
a. Rust, p. 316.

Corn. ÷ ½.



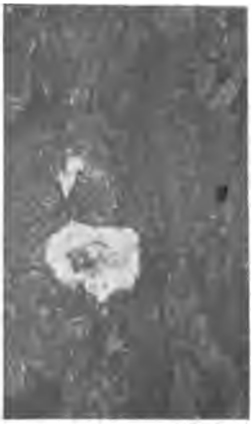
b. Smut, p, 317.

Currant. × 3.



c. Red Knot, p. 319.

Elm Bark. × 2.



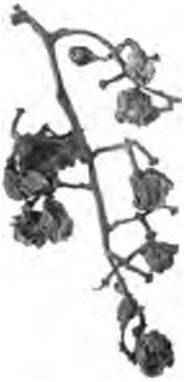
d. White Fungus on Elm-Leaf beetle, p. 321.

FUNGI OF CLOVER, CORN, CURRANT, ELM BEETLE.

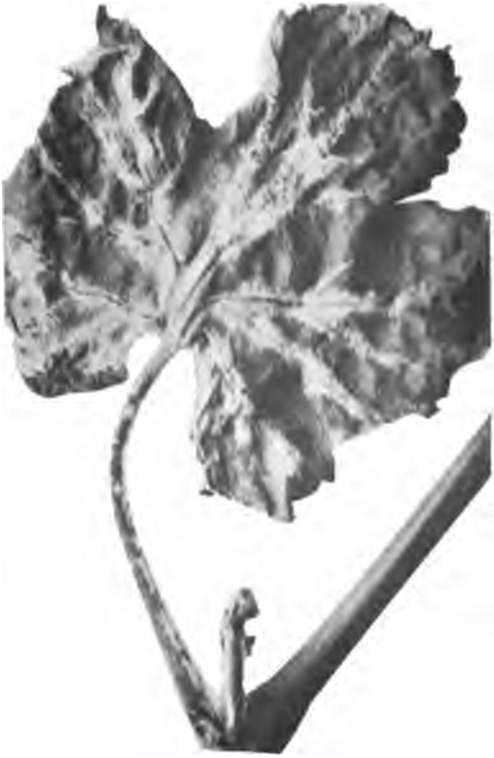
PLATE XVII.

Grape.

÷ ½

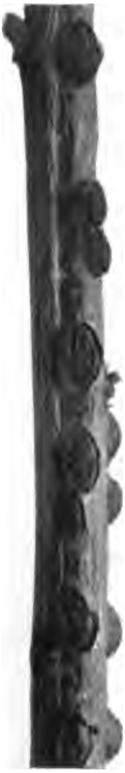


a. Black Rot, p. 323.



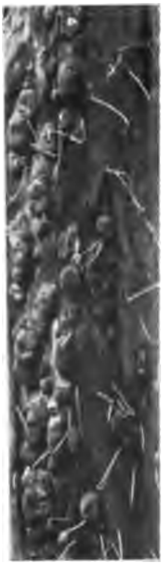
b. Downy Mildew, p. 324.

Hazel × 2



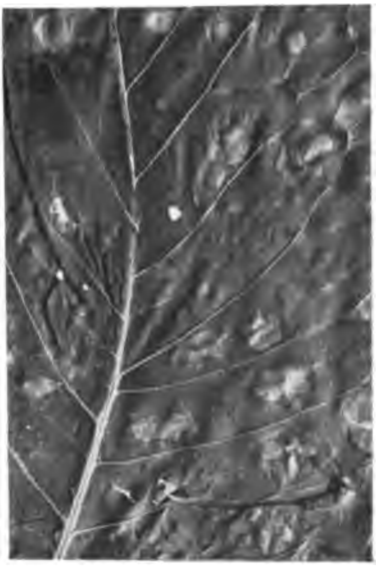
c. Black Knot, p. 325.

Hollyhock × 2.



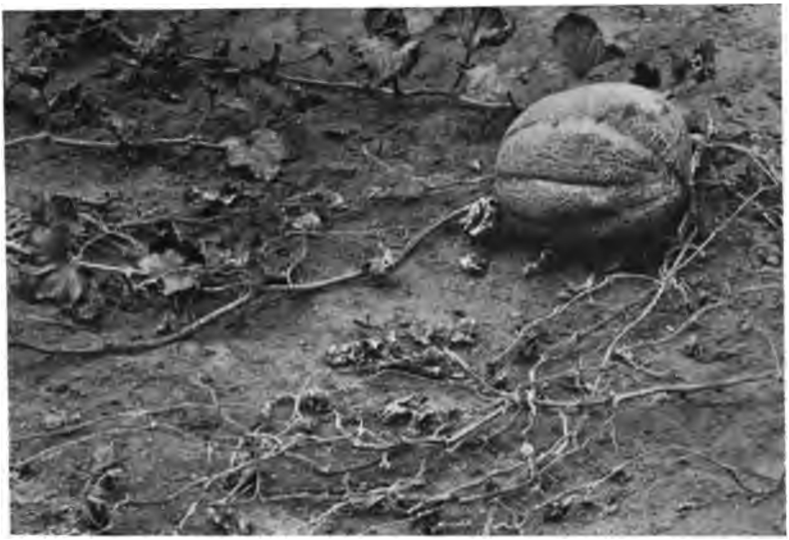
d. Rust, p. 326.

Horseradish.

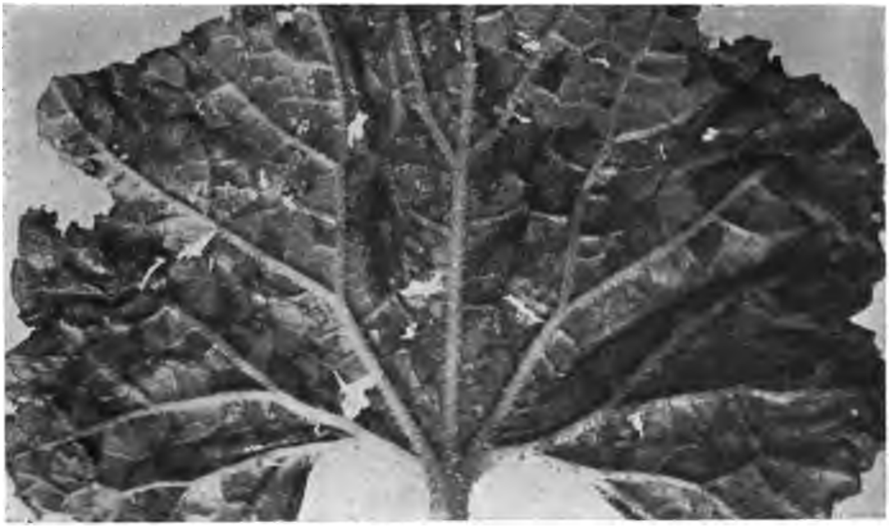


e. Leaf Spot, p. 327.

FUNGI OF GRAPE, HAZEL, HOLLYHOCK, HORSERADISH.



a. Blighted vine in the field.

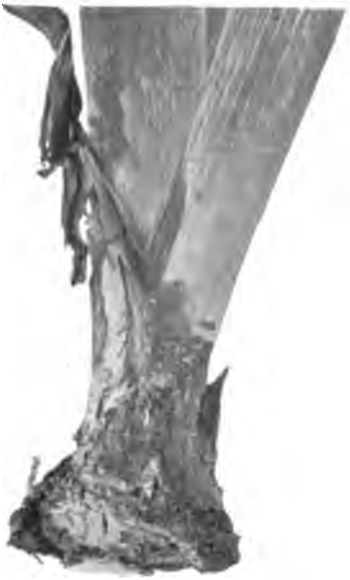


b. Under surface of leaf showing dead areas.

BLIGHT OR DOWNY MILDEW OF MUSKMELON, p. 330.

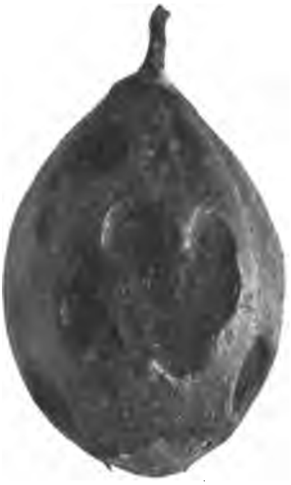
PLATE XIX.

Iris.



a. Rootstock Rot, p. 327.

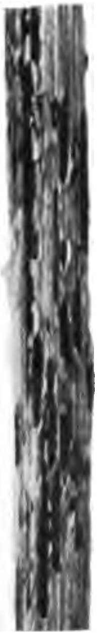
Musk Melon.



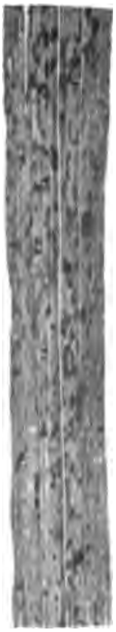
b. Scab, p. 331.

Oats.

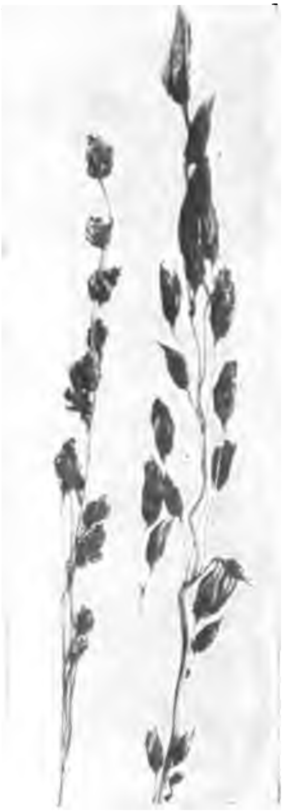
On stem. ×2 On leaf.



c. Black Rust, p. 332.



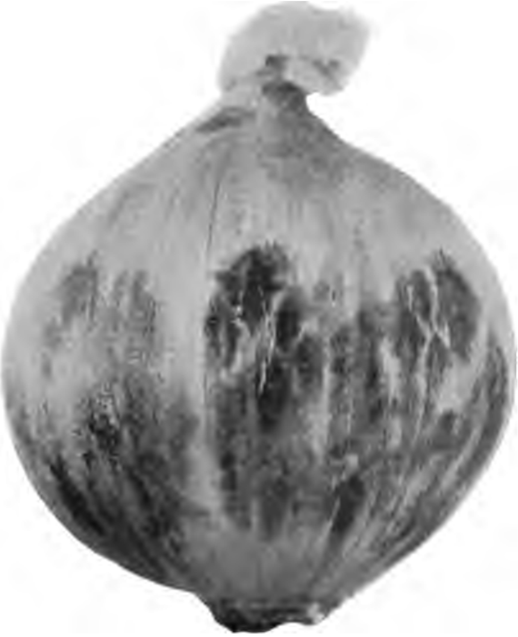
d. Crown Rust, p. 333.



e. Smut, p. 333.

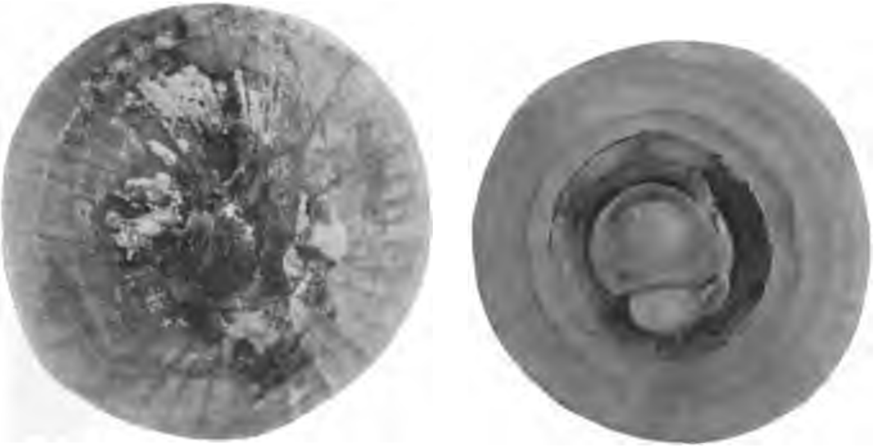
FUNGI OF IRIS, MELON, OATS.

PLATE XX.



a. Black Spot, p. 333.

Stem Rot, p. 334.

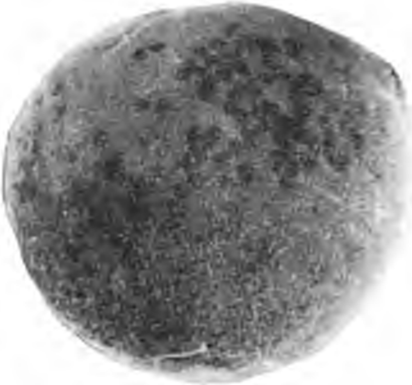


b. End view.

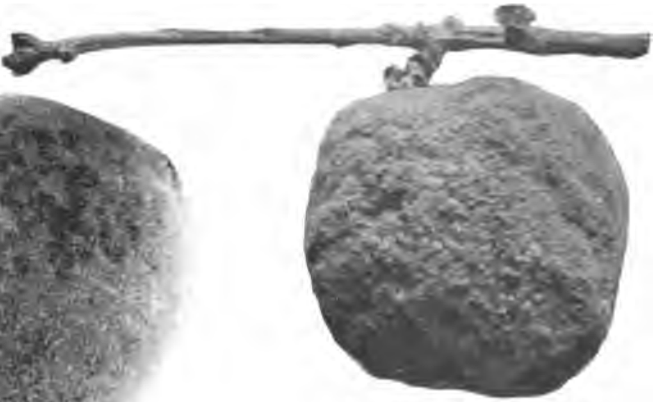
c. Cross-section.

FUNGI OF ONION.

PLATE XXI.

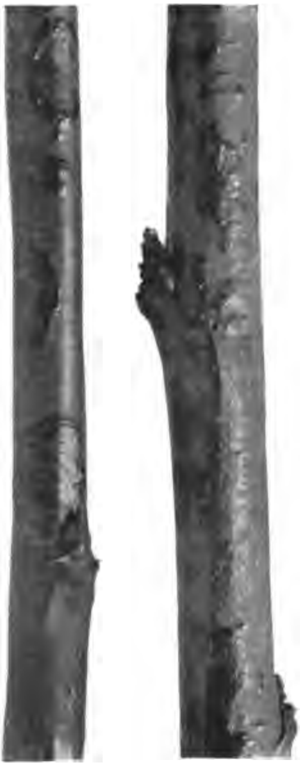


a. On fruit.

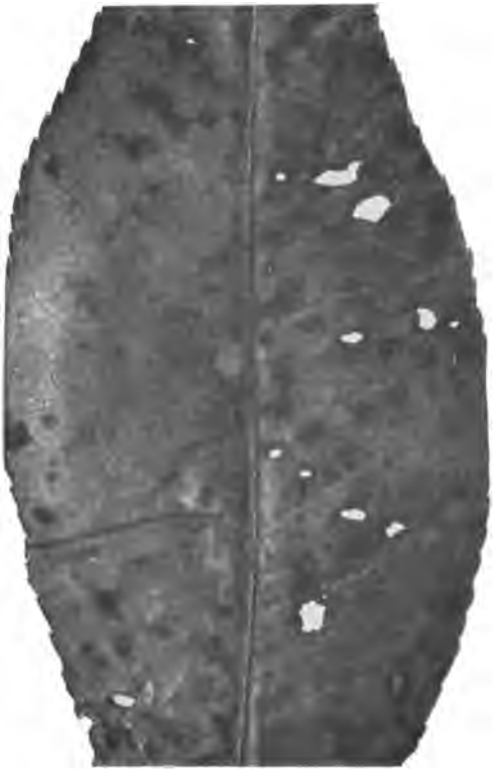


b. Brown Rot, p. 337.

Scab, p. 340.



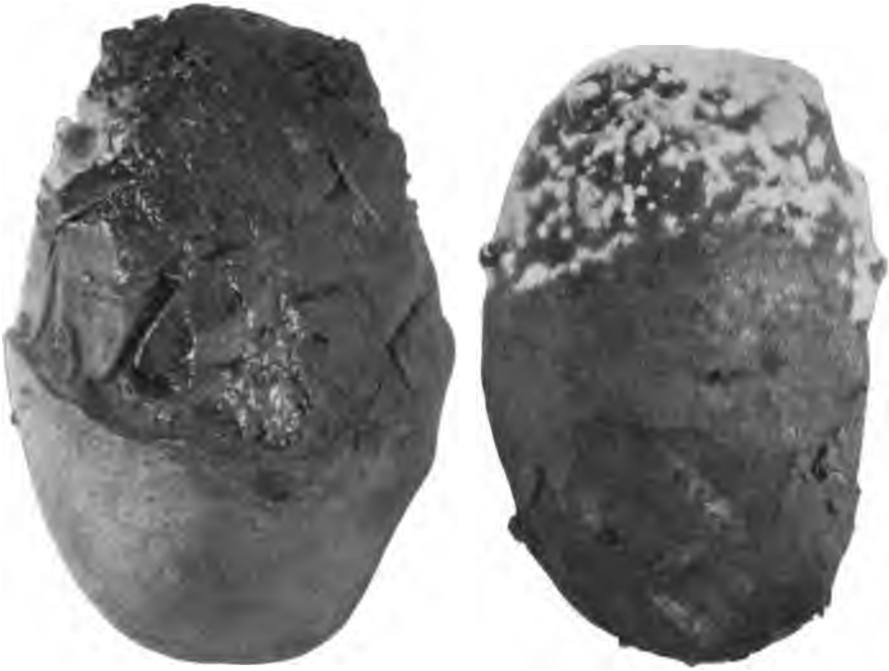
c. On twigs. × 2.



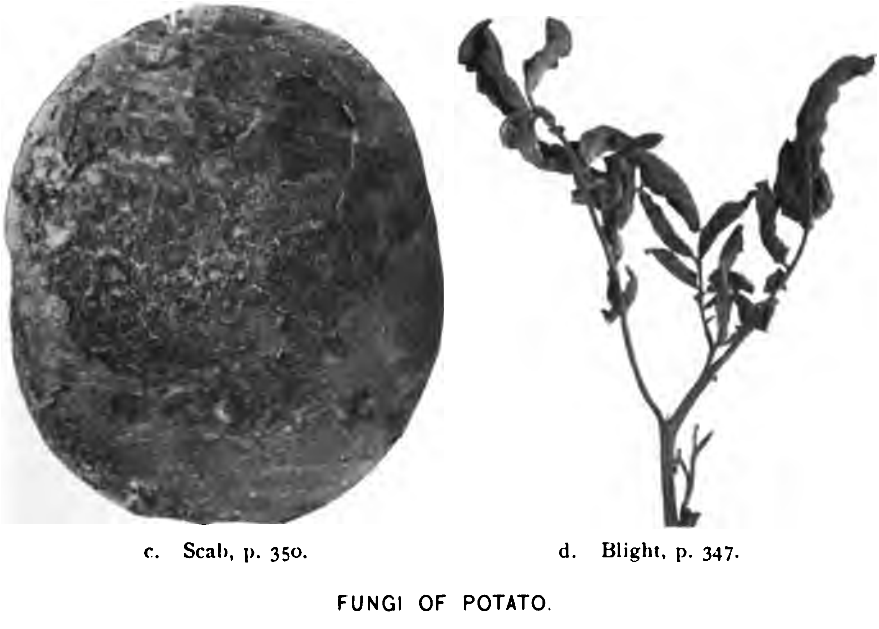
d. On leaf. × 2.

FUNGI OF PEACH.

PLATE XXII.



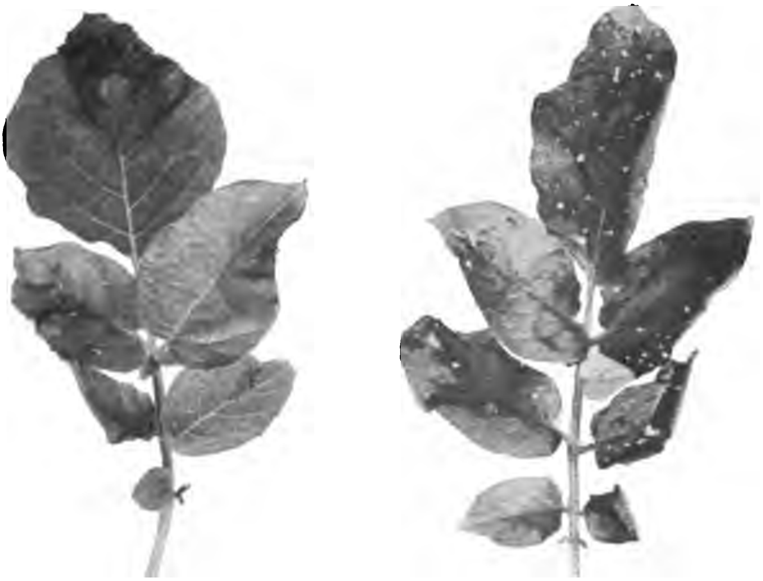
a. Bacterial Rot, p. 350. b. Dry End Rot, p. 349.



c. Scab, p. 350. d. Blight, p. 347.

FUNGI OF POTATO.

PLATE XXIII.



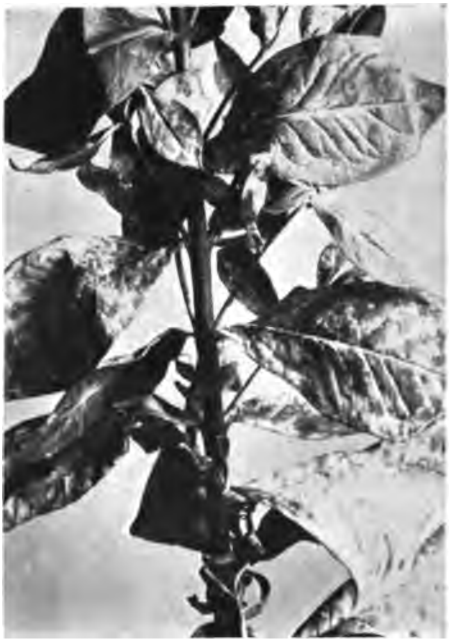
a. Green leaves showing early stage of blight. p. 347.

b. Todd's blighted field, photographed July 28, 1902; less than a week before, this field was perfectly green.

BLIGHT OF POTATO.

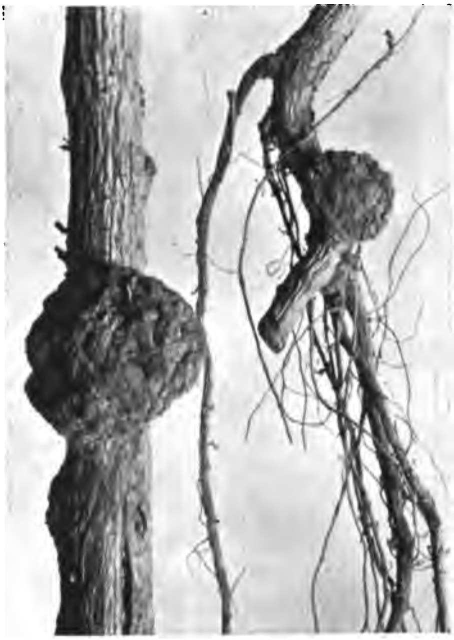
PLATE XXIV.

Phlox.



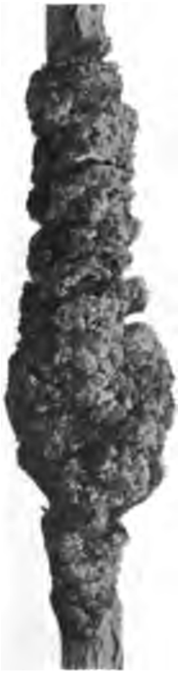
a. Powdery Mildew, p. 345.

Plum.



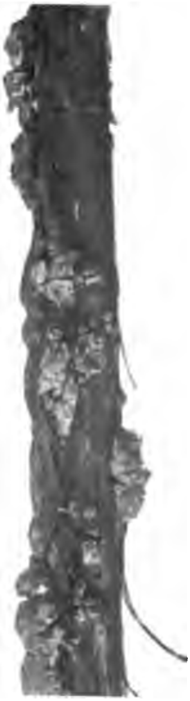
b. Crown Gall, p. 346.

Plum.

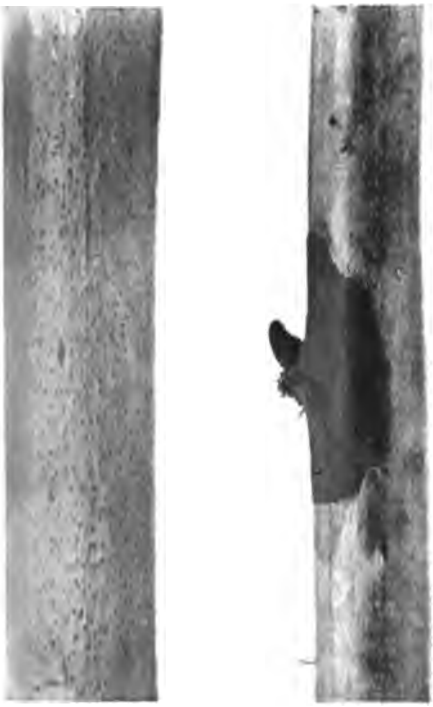


c. Black Knot, p. 345.

Raspberry.



d. Crown Gall, p. 354.

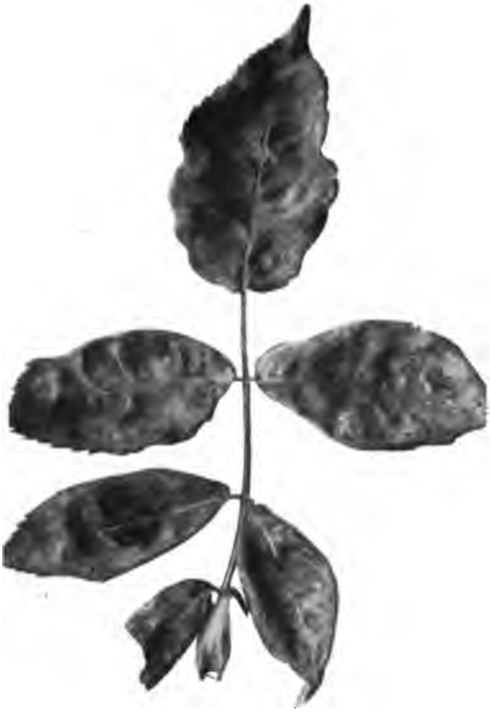


e. Cane Blight, p. 353.

FUNGI OF PHLOX, PLUM, RASPBERRY.

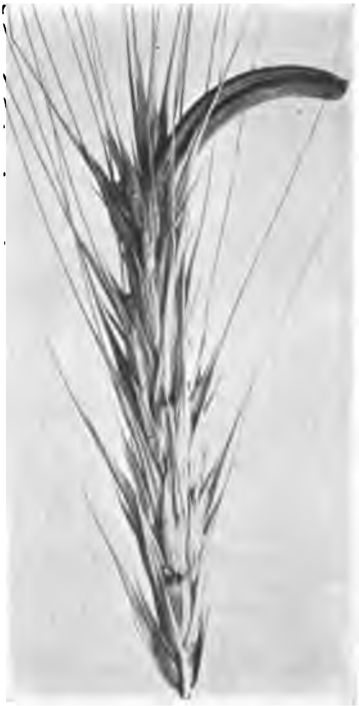
PLATE XXV.

Rose.



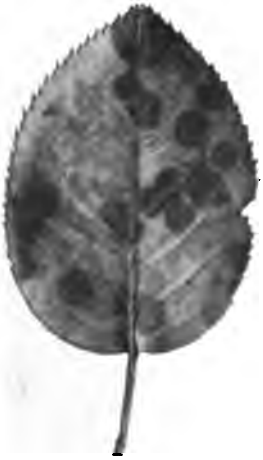
a. Powdery Mildew, p. 356.

Rye.



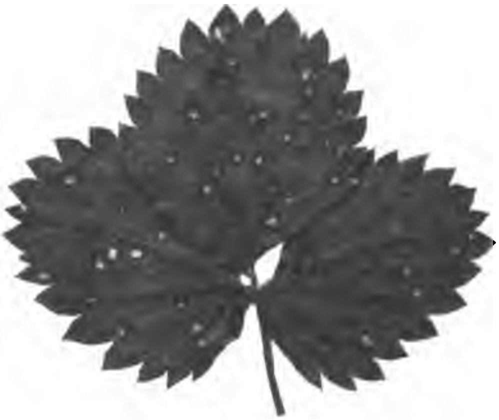
b. Ergot, p. 357.

Rose.



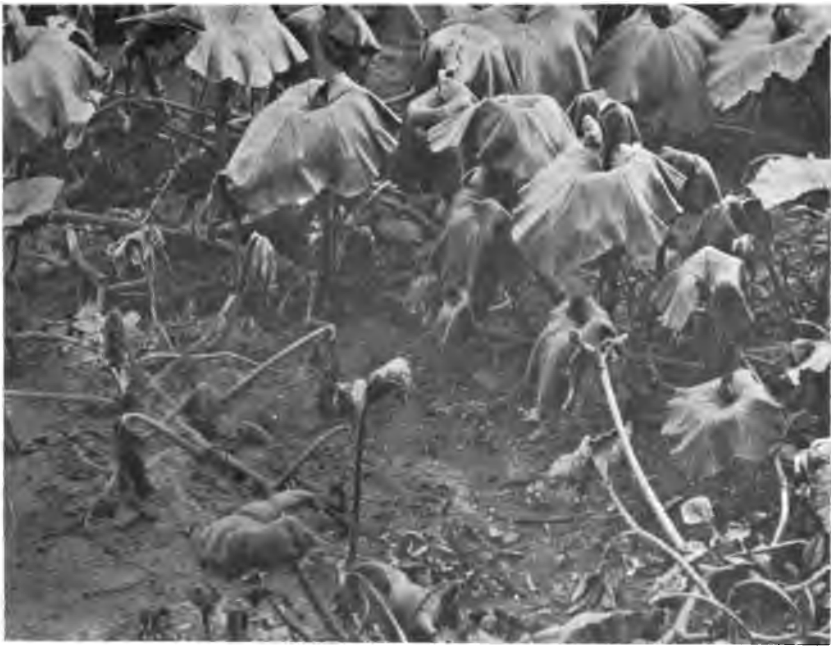
c. Leaf Blotch, p. 355.

Strawberry.

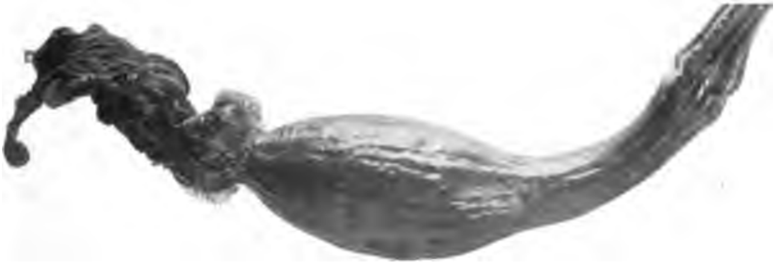


d. Leaf Spot, p. 360.

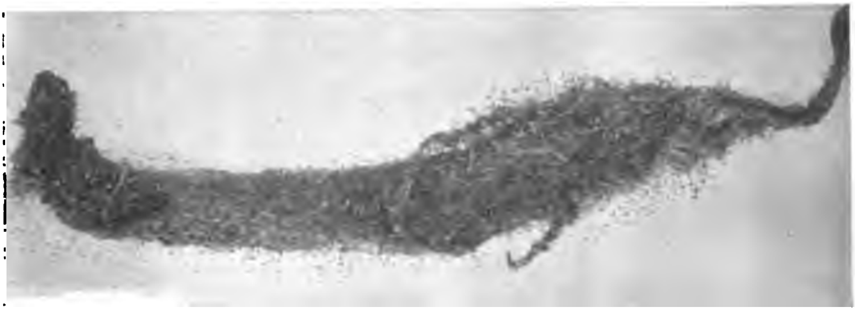
FUNGI OF ROSE, RYE, STRAWBERRY.



a. Bacterial Wilt, p. 359.



b. Black Mold at base of blossom, p. 358.

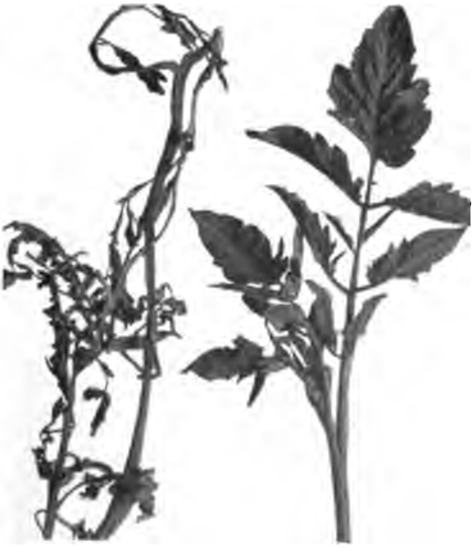


c. Metallic Mold on blossom, p. 359. × 2.

FUNGI OF SQUASH.

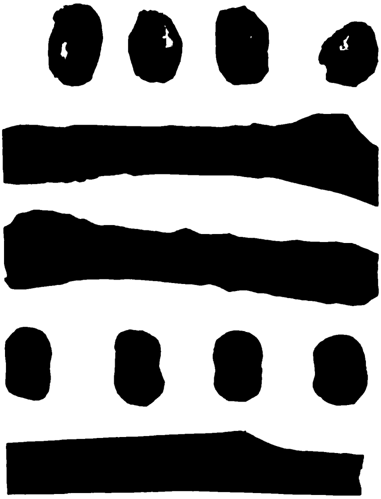
PLATE XXVII.

a. Showing area in A. Ure's tomato field where blight killed many plants.



Blighted. Healthy.

b. Tomato leaves.

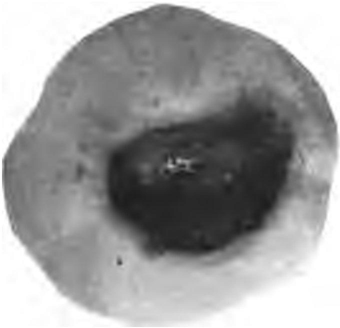


c. Cross and longitudinal sections of tomato stems. Upper three rows blighted; lower two rows healthy stems.

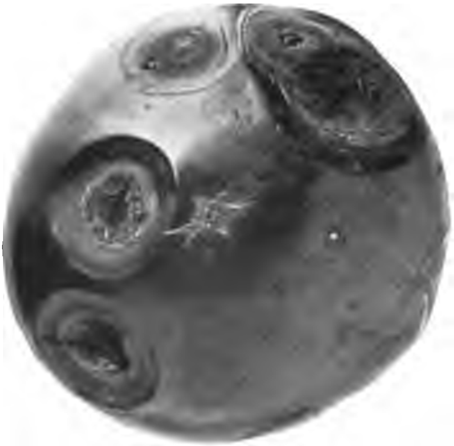
BACTERIAL BLIGHT OF TOMATO, p. 364.

PLATE XXVIII.

Tomato.

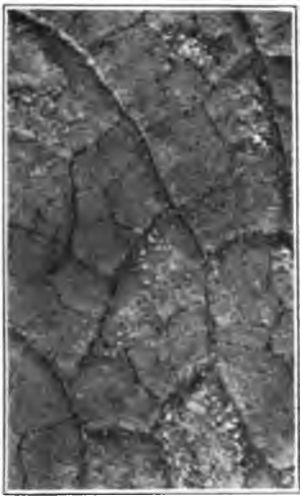


a. Point-Rot, p. 367.



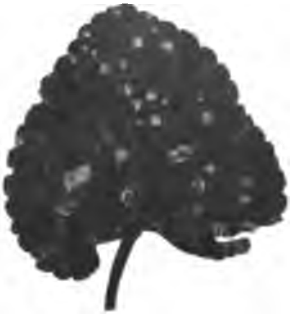
b. Anthracnose, p. 364.

Turnip, × 2



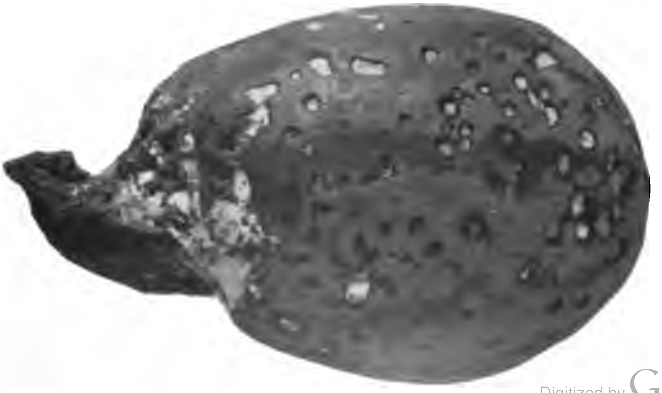
c. Downy Mildew, p. 367.

Violet.



d. Spot Disease, p. 368.

Young Watermelon.



e. Anthracnose, p. 369.

FUNGI OF TOMATO, TURNIP, VIOLET, WATERMELON.

COMMERCIAL FEEDING STUFFS.*

THE LAW REGULATING THEIR SALE.

Section 4591 of the general statutes of Connecticut so defines the term "concentrated commercial feeding stuff" that it covers practically all feeds *excepting the following:*—hay and straw, whole seeds, unmixed meal made directly from any one of the cereals or from buckwheat, and feed ground from whole grain and sold directly from manufacturer to consumer.

Section 4592 requires that every package of concentrated commercial feeding stuff shall bear a statement giving the name and address of manufacturer or importer, the number of net pounds in the package, the name of the article and the percentages of protein and fat contained in it.

Section 4593 requires every manufacturer, importer, agent or seller to file with this Station, upon request, a certified copy of the statement above described.

The penalty prescribed for violation of the foregoing sections is not more than $100 for the first offense and not more than $200 for each subsequent offense.

Section 4595 authorizes this Station to take samples from any manufacturer, importer, agent or dealer in a prescribed fashion and requires this Station to analyze, annually, at least one sample of each brand which it has collected and to publish these analyses in station bulletins, "together with such additional information in relation to the character, composition and use thereof as may be of importance."

The Dairy Commissioner is charged with the enforcement of the provisions of these sections of the statutes.

In compliance with the requirements of this law the following report on feeding stuffs has been prepared.

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* The substance of this chapter was published as Bulletin No. 145.

SAMPLING OF COMMERCIAL FEEDING STUFFS.

During the fall of 1903, Mr. V. L. Churchill, the sampling agent of this Station, visited forty-eight towns and villages of this state and took three hundred and four samples of feeds in the way prescribed by law. These samples have been examined chemically and microscopically and the results appear in the following pages with appropriate discussion.

There are also given twenty-four analyses of feeds which were sent to the Station for analysis by individuals.

To make it easier to understand these analyses and their discussion, the following explanations are prepared:—

EXPLANATIONS OF ANALYSES OF FEEDING STUFFS.

An analysis gives the percentage amounts of Water, Ash, Protein, Fiber, Nitrogen-free Extract, and Fat.

Percentage Amount is the amount in 100. If the protein in a feed is 17.5 per cent., every 100 pounds of that feed contains 17.5 pounds of protein; and since a ton is twenty hundred pounds, a ton of the feed will contain twenty times 17.5, or 350 pounds of protein.

Water. However dry a feeding stuff may appear to be, it always contains a considerable and variable quantity of water which cannot be seen or felt, but which can be driven out by heat. The amount of water thus present in feeding stuffs is constantly changing with the temperature and dryness of the air about them, and accordingly no very close comparison of different feeds is possible unless the proportions of water they contain are known and comparison is made on perfectly dry or water-free substance.

Ash is what is left when the combustible part of a feeding stuff is burned away by heating to faint redness in a current of air and besides a little charcoal and sand, which are accidental impurities, consists chiefly of lime, magnesia, potash and soda, combined with chlorine and carbonic, sulphuric and phosphoric acids.

Protein is a general term which includes all those nitrogenous materials of a concentrated feeding stuff which, when separated in a pure state, bear a general resemblance in composition and properties to egg albumin (white of egg), flesh fibrin (lean meat), and milk casein (curd). It is from this protein of the food alone that the animal can make albumin, fibrin and casein. The nitrogenous materials are the most costly and by far the most valuable ingredients of concentrated commercial feeds, which should be bought chiefly for the protein which is in them.

Nitrogen-free Extract, sometimes called *Carbohydrates,* includes starch, gum, sugar and pectin bodies. They are readily extracted from the feeding stuff by water and dilute acid.

Fiber is the essential constituent of the walls of vegetable cells and is seen in a nearly pure state in cotton fiber or paper pulp. It is the most insoluble part of the vegetable substance and of quite subordinate value in the ration.

Ether Extract includes fat oil, solid fat, wax, chlorophyl (the green coloring matter of plants), and other coloring matters, in brief everything which can be extracted from the perfectly dry feeding stuff by absolute ether.

Regarding the uses of the above-named parts of feeds:

Water and *ash* need not be considered, for, while indispensable to stock, both are abundantly supplied in other ways than in commercial feeds.

Protein may easily be made over by the animal into its own substance, i. e., into muscles, tendons and the various working tissues and membranes, because these necessary parts of the animal machine are themselves made up of the same kind of materials, or, chemically speaking, have the same composition as the protein bodies.

Fiber and the *nitrogen-free extract,* on the other hand, cannot serve for building up the muscles and other parts of the growing animal and cannot restore the waste and wear of those parts of mature animals, because they are of a very different nature. They contain no nitrogen, an element which enters into all the animal tissues (proteins), to the extent of some sixteen per cent. of their dry matter.

Fiber and the *nitrogen-free extract* cannot restore the worn-out muscles or membranes of the animal any more than coal can be made to renew the used-up packing, bolts, valves, flues and gearing of a steam-engine. Proteins are to the ox or the man what brass and iron are to the machine, the materials of construction and repair.

Fat, fiber and *nitrogen-free extract* are, furthermore, to the animal very much what coal and fuel are to the steam-engine. Their consumption generates the power which runs the mechanism. Their burning (oxidation) in the blood of animals produces the results of life just as the combustion of coal in the fire-place of the steam-engine produces the motion and power of that machine. For this combustion in the system, digestible fat has more than twice the value of digestible nitrogen-free extract.

There is, however, this difference between the engine and the animal: the former may be stopped for repairs; the latter may run at a low rate, but if it be stopped it cannot resume work. Hence the repairs of the animal must go on simultaneously with its wastes. Therefore, the material of which it is built must admit of constant replacement, and the dust and shreds of its wear and tear must admit of escape without impeding action. The animal body is as if an engine were fed not only with coal and water, but with iron, brass and all the materials for its repair, and also is as if the engine consumed its own worn-out parts, voiding them as ashes or as gas and smoke. Proteids, or the blood- and tissue-formers, are thus consumed in the animal, as well as the fat, fiber and nitrogen-free extract or fuel proper. The fact that proteids admit of consumption implies that when the proper fuel is insufficient, they may themselves serve as fuel. Such is the case, in fact. But, nevertheless, the two classes of substances have distinct offices in animal nutrition, and experience has demonstrated that for each special case of animal nutrition a special ratio of digestible proteids to digestible fat, fiber and nitrogen-free extract is the best and most economical, and, within certain limits, is necessary.

The Uses of Analyses of Feeding Stuffs.

These uses are several. First, by an analysis compared with the average of others, any buyer of a feed can see whether it is of the usual quality. Thus on page 399, the analysis of cotton seed meal, No. 10983, compared with the average of twenty-five analyses given on the same page, shows that its quality is far below average as regards protein, the most valuable ingredient.

Secondly, by an analysis compared with the manufacturer's guaranty the buyer can see whether in composition the feed meets what is claimed for it. Thus on page 411 the analyses of cream gluten show that the feed contained on the average about 3 per cent. more of protein than was called for by the manufacturer's guaranty.

Thirdly, an analysis often shows clearly whether or not the feed is adulterated and may indicate also the form of adulteration. This use is fully illustrated by the discussion of adulterated wheat feeds on page 380 of this report.

It also makes clear the composition of mixtures which are sold under names which either convey no meaning or convey a false impression. Thus the analysis of a "ground oil cake compound" given on page 427, and mentioned on page 391, shows that instead of being prepared from the expressed meal of some oil seed, like linseed, it is merely ground wheat screenings consisting largely of weed seeds.

Fourthly, comparison of analyses of a number of kinds of feed with their prices will greatly help in deciding whether any one of them is worth to the feeder what is asked for it. Too often the prices of feeds bear no relation to their real feeding value.

Lastly, the chief use of these tables by feeders should be as a guide to the skillful compounding of rations for farm animals. How this is done cannot be briefly explained within.the limits of a bulletin. A knowledge of the principles of cattle feeding is essential, which should be gathered by studying books which treat of the principles of cattle-feeding and of the art of compounding rations.

DISCUSSION OF THE ANALYSES.*

COTTON SEED MEAL.

Analyses on pages 398-9.

The average percentage of protein in the twenty-five samples examined is lower this year than for some years past, being 43.16.

The following brands fail to meet the manufacturers' guarantee by more than 0.7 per cent. of protein:

A. B. C. brand, Augusta Brokerage Co.; American Cereal Co.; American Cotton Oil Co. (one sample); R. W. Biggs Co. (two samples); Green Diamond brand (two samples); Hayley & Hoskins, Star brand; Sunflower brand (three samples).

By the rules of the Cotton Seed Crushers Association, "choice" meal must contain at least 8 per cent. of ammonia, equivalent to 41.19 per cent. of protein, and "prime" meal must contain at least 8 per cent. of ammonia, or if from the South Atlantic States 7½ per cent. of ammonia, equivalent to 38.62 per cent. of protein. By this standard two of the samples, Hayley & Hoskins' 10983, and Sunflower brand, sold by the American Cereal Co., 11074, were neither "choice" nor "prime" meal. Regarding sample 10983, however, Messrs. Hayley & Hoskins write that at the time of sale they advised the buyer that it was the last carload of old season's prime, and they were loath to make the sale as it had lain six or seven months in warehouse and might show deterioration.

A sample of Hayley & Hoskins' prime meal, 10063, sent for analysis by Meech & Stoddard of Middletown, contained 42.62 per cent. of protein.

The average percentages of protein and fat, as determined at this Station, and the average prices, quoted by retailers, at the time the samples were drawn, have been as follows for the last four years:

---

* The microscopic work in connection with the analyses reported in this paper was wholly done by Mr. Winton; the chemical analyses were made by Messrs. Ogden, Silverman and Bailey; the results were prepared for publication by the director.

	1899	1900	1901	1902	1903
No. of Samples	10	4	6	8	25
Percentage of protein	46.4	43.9	44.4	43.0*	43.16
" " fat	10.4	8.6	9.8	10.3	9.22
Average price	$24.00	27.00	28.80	29.70	29.04

The price of cotton seed meal has risen in the last five years, and the average percentage of protein has on the whole declined.

LINSEED MEAL.

Analyses on pages 400–1.

"Linseed Meal," "Oil Meal," and "Flax Seed Meal" are trade names for ground flax seed from which more or less of the oil has been removed. By the "old process" the oil is partly removed by pressure, leaving, however, from 5 to 10 per cent. of oil, "fat," in the meal. By the "new process" the oil is so far extracted with benzine as to leave less than two and a half per cent. in the meal. New process meal is more uniform in composition and contains more protein than old process meal. All the samples of each kind analyzed this year have been of good quality and unadulterated. The average percentages of protein and fat found in linseed meal for the last four years, as determined at this Station, with the average prices at the time the samples were drawn, as quoted by retailers, are as follows:

	New Process.				Old Process.			
	1900	1901	1902	1903	1900	1901	1902	1903
No. of Samples	2	3	4	2	3	4	6	9
Percentage of protein	38.4	39.0	39.8	36.4	31.3	34.4	32.8	33.1
" " fat	2.4	1.8	2.1	3.2	6.7	7.7	7.8	7.5
Average price	$32.50	30.00	31.00	32.50	31.00	30.50	32.00	30.77

Neither of the samples of new process linseed meal met the manufacturer's guaranty, in respect of protein.

Two samples of old process meal, from the Midland Linseed Co., Minneapolis, did not bear the statement of guaranty which is required by law.

The following brands did not contain the guaranteed amounts of protein:

---

* 43.7 including 4 other partial analyses.

11241. Export brand Linseed Meal, Chapin & Co., Boston. Found 31.44, guaranteed 36.0.

10951. Sold by Hammerstein & Co., Buffalo, N. Y. Found 34.06, guaranteed 38.3.

11117. Sold by Hunter Bros., St. Louis, Mo. Found 31.19, guaranteed 34.0.

11133. Sold by Metzger Seed and Oil Co., Toledo, Ohio. Found 31.75, guaranteed 34.0.

Guarantees of from 35 to 38 per cent. of protein in old process meal would seem unsafe and unreasonable, for this article, as found in our market, seldom contains as much as 35 per cent. of protein.

Linseed meal can usually be bought in car lots at about the same price as cotton seed meal and at this writing for $2.00 per ton less than cotton seed meal. The high retail price usually quoted, $31 to $32, is because of the small demand for linseed, which "moves slowly" in the retail trade, although it is a concentrated, palatable and safe feed.

Wheat Products.

These are by-products in the manufacture of wheat flour. Several different processes of milling are in common use, yielding by-products which are not entirely alike in composition. The products made from winter wheat also differ in composition from those from spring wheat.

Wheat Bran consists of the outer layers of the wheat berry, which are dark in color and do not easily pulverize.

Wheat Middlings, as found in the feed market, consist of inner layers of the covering of the berry, which are lighter in color and more easily pulverized than bran, and of other parts from which fine white flour cannot be made.

Red Dog Flour is the poorest grade of flour; off color and often sold as a cattle food.

Many mills do not sell bran and middlings separately, but run them together, often with other waste wheat products, and sell the mixture as "Mixed Feed."

With few exceptions the samples of wheat feed described in the tables of analyses were not accompanied, as is required by law, with any statements of composition.

Bran from Winter Wheat.

Analyses on pages 400–1.

The seven samples examined are all genuine with no evidence of any wilful admixture of foreign matter. Fragments or the whole grains of certain weed seeds are commonly found in bran and other wheat feeds. These are things which screening does not perfectly separate from the wheat and which therefore come out with the bran in the milling process.

Samples 11004, 10947, and 11038 contain rather larger amounts of this foreign matter than the other samples. Sample 11087 is a very light-colored bran, quite free from foreign matters, but made from soft Canadian wheat, which perhaps explains its unusual composition. The protein in this sample, 12.81 per cent., is 2.7 per cent. less than the average found in the six other samples examined, 15.52 per cent.

The average amount of protein found this year in winter bran is also considerably less than has been found in recent years, as appear in the statement on page 381.

Bran from Spring Wheat.

Analyses on pages 400–3.

All of the sixteen samples collected are unadulterated and of good quality though containing rather less protein than has been found in other recent years.

A single sample of spring bran, 10863, made by the Porter Milling Co. and sent by G. M. White & Co. of East Hartford Meadow, contains 15.37 per cent. of protein.

Middlings.

Analyses on pages 402–5.

The samples, with few exceptions, are of fair quality. Sample 10961, from the Randall Mill Co., Tekonsha, Mich., contains no excessive quantity of foreign matter, but has only 12.62 per cent. of protein, a very low per cent. of fiber and seven per cent. more of starchy matter than the average.

Sample 11136, Colonial Middlings, made by the Miner-Hillard Mill Co., Wilkesbarre, Pa., is not a pure wheat middlings but a mixture of wheat and corn products containing 3½ per cent. less of protein and 0.7 per cent. more of fat than pure wheat middlings and sold apparently for $1.50 per ton more than the latter. The guaranteed percentage of protein is 13.56, which is fully met by the analysis. The amount of fat found, 5.73 per cent., is a per cent. less than is guaranteed. Both the samples above named are excluded from the average given in the tables.

The average percentage of protein found this year in the winter and spring middlings is considerably less than it has been in recent years.

Mixed Feed from Winter Wheat.

Analyses on pages 404–9.

Most of the thirty-eight samples examined are of fair quality. Sample 11012 contains some traces of corn cob, and 11127, a small amount of cracked corn, but not enough to seriously affect the chemical composition.

No. 11063. The Ideal Mixed Feed, made by Charles R. Lull of Milwaukee, Wis., contains many oat hulls or oats which reduce the percentage of protein to 1.7 per cent. below the average for mixed feed and raise the percentage of woody fiber by 4.3 per cent. This article is guaranteed to contain 17.6 per cent. of protein and 3.0 per cent. of fat. It contains less protein than is guaranteed by 2.6 per cent. On account of these facts this analysis is excluded from the average. The average composition shows less protein than the averages of previous years.

Spurious Mixed Feed.

Among the unclassified mixed feeds are two which, while bearing the name mixed feed, are not mixed feed in the sense in which the term is generally used in the feed trade, but are mixtures of wheat feed and corn cobs, a material greatly inferior to wheat bran in feeding value. One of them is sold above the average price of genuine mixed wheat feed, the other for $1.50 per ton below it.

One of them, 11029, Blue Grass Mixed Feed, comes from Henderson, Kentucky, which seems to be the home of this kind of material; the other, 11237, is sold by Balch & Platt, of Winsted, who state that they are unable to say from whom they bought the feed.

Mixed Feed from Spring Wheat.

Analyses on pages 408-11.

All of the eighteen samples mentioned in the table are pure, though two of them, Nos. 11048 and 11256, contain an undue proportion of weed seeds or fragments of them. The average percentage of protein is lower than it has been for the three years preceding.

A sample of Diamond Mixed Feed, 11288, made by Annan, Burgh & Co., St. Louis, sent by G. M. White & Co., East Hartford Meadow, contained 17.38 per cent. of protein.

Average Composition of the Various Pure Wheat Products.

The average composition of the various pure wheat feeds sold in Connecticut in the last five years, with their prices, as given by retailers, appear in the following table:

AVERAGE COMPOSITION AND PRICE OF WHEAT FEEDS IN CONNECTICUT IN 1899, 1900, 1901, 1902 and 1903.

	Bran.		Middlings.		Mixed Feed.	
1899	Winter.	Spring.	Winter.	Spring.	Winter.	Spring.
Protein	15.9	15.6	15.8	15.6	16.8	16.8
Fat	4.3	4.7	4.4	4.7	4.5	5.1
Ton price	$19.80	19.14	19 00	19.25	19.44	19.25
1900						
Protein	16.1	16.5	17.7	19.1	18.1	17.6
Fat	4.6	5.0	4.7	5.5	4.7	5.3
Ton price	$21.09	20.00	21.00	21.50	21.00	20.80
1901						
Protein	16.3	17.3	18.0	19.7	17.5	18.5
Fat	4.5	4.7	5.0	5.5	4.7	5.1
Ton price	$21.80	21.06	22.75	22.10	22.20	22.20
1902						
Protein	17.1	16.7	18.1	19.2	17.7	17.7
Fat	4.6	4.9	4.4	5.4	4.6	5.1
Ton price	$23.37	20.90	23.85	23.44	22.00	22.35
1903						
Protein	15.5	15.9	16.4	17.9	16.7	16.9
Fat	4.5	4.9	4.5	5.0	4.5	5.0
Ton price	$23.00	22.50	25.55	25.50	23.55	23.53

This table indicates that:

1. The spring wheat products, as a rule, have somewhat higher percentages, both of protein and fat, than the winter wheat products.
2. This difference is rather more pronounced and constant in the case of middlings than in that of either bran or mixed feed.
3. The percentages of protein in bran are rather lower than in either middlings or mixed feed.
4. On the average the winter wheat products sell at a slightly higher price than the spring wheat products in spite of the higher protein and fat content of the latter.
5. The percentages of protein in all the wheat feeds have been considerably lower in 1903 than in either of the three years immediately preceding. The prices have, however, ruled higher.

Guaranties of Wheat Feeds.

The law requires that wheat feeds shall be sold with a guaranty of composition.

Of the one hundred and twenty-one samples examined, only eight had a guaranty that could be found by our agent.

The American Cereal Co. and the Brooks Elevator Co. are the only manufacturers of genuine mixed wheat feed which, as far as we can learn, have offered guaranties.

On the other hand, the mixtures which are not genuine mixed wheat feed but resemble it in appearance, are sold at about the same price and are called "mixed feeds," have a guaranteed composition.

It has been urged that wheat feeds are staple articles, uniform in composition and not adulterated and therefore that no guaranty was needed. But our analyses show that these feeds vary decidedly in composition from year to year and that there is more fraud in the sale of mixed feed than we have found in the sale of any other feed on the market. If the buyer can get no guaranty that his wheat feeds are of standard quality and if they are commonly adulterated, he must drop them for the gluten feeds and dried brewers and distillers grains, which are more constant in composition and with which a guaranty is given.

CORN PRODUCTS.

Maize Meal and Maize Bran.

Analyses on pages 410–11.

The three analyses of meal show lower percentages of both protein and fat than the average of forty-eight analyses made a year ago. This is to be explained, probably, by the poor quality of the 1902 crop.

Gluten Meal.

Analyses on pages 410–11.

A single brand only of gluten meal was found in the State this year, viz: Cream Gluten, made by the Illinois Sugar Refining Co. of Chicago.

The percentages of protein and fat in the three samples examined were well above the guaranty.

Gluten Feed.

Analyses on pages 410–15.

Fourteen samples of Buffalo Gluten Feed, made by the Glucose Sugar Refining Co. of Chicago, contain an average of 24.21 per cent. of protein and 3.15 of fat.

The guaranty calls for 27.5 to 28.0 per cent. of protein and 3.0 of fat.

The guaranty of Chicago gluten is stated to refer to the *water-free meal.* To the feeder it is of no great importance to know what the feed would contain if there were no moisture in it, but it is of great importance to know what it contains as he finds it in market. There is no good reason why this information should not be given in the guaranty. A guaranty which does not give it is of no practical use to the purchaser.

A guaranty of 27.5 per cent. of protein *in the dry matter* would be equivalent to 24.8 per cent. of protein in goods with the average percentage of moisture in them. With this reduction, the protein in the samples examined is only 0.6 per cent. below guaranty. The writer has been verbally informed by a representative of the Commercial Products Co., that probably because of the greater amount of white corn in market this year and therefore necessarily used in their works, the percentage of protein in the feed has fallen unexpectedly. Five brands of gluten feed, other than the Buffalo, have been analyzed and the average percentages of protein and fat in every brand are very considerably less than the respective guaranties.

No. 11150 K. K. Gluten Feed contains much less protein than is guaranteed. Another sample, sent soon after this sample was drawn, by R. G. Davis, New Haven, No. 11273, contained 23.69 per cent. of protein, 2.47 per cent. of fat.

A representative of J. E. Hubinger Bros. & Co., the manufacturers, stated that both samples were from the very first run of the new factory and he brought three samples stated to have been sampled by R. G. Davis from subsequent shipments.

The analyses of these three samples follow:

	11281	11282	11283
Water	7.05	6.88	6.68
Ash	1.02	0.99	1.04
Protein	24.25	24.06	25.38
Fiber	7.25	7.23	6.64
Nitrogen-free Extract	56.02	56.46	56.18
Fat	4.41	4.38	4.08
	100.00	100.00	100.00

Four other samples of gluten products were sent by individuals, as follows:—

10151. "Gluten Meal," sent by C. H. Williams, Burnside, with the statement that it had injured stock which ate it. It contained 27.37 per cent. of protein but no poisonous substance was found. It is not gluten meal of average quality.

10555. Globe Gluten Feed, sent by Chapin & Co., from car shipped to I. W. Beers, Hamden, contained 24.00 per cent. of protein.

10271. Gluten Feed, manufacturer unknown, sent by G. W. Strant, South Manchester, contained 23.69 per cent. of protein.

11190. Sent by Andrew Kingsbury, R. D. Rockville, who states that it is sold by Rockville Milling Co. for $26.00 per ton; bought for "Chicago Gluten Meal." The sample contained 23.00 per cent. of protein and 3.69 per cent. of fat;—less protein than the standard gluten feeds and far less than gluten meal. It is certainly not gluten meal. The factory where Chicago gluten meal was made was burned two years ago, and has not been replaced.

Hominy Meal, Hominy Chop.

Analyses on pages 414–17.

Of the twenty-seven samples examined, three are very inferior as shown by analysis. No. 11050, Star Hominy Meal, made by the Toledo Elevator Co., and sold by W. T. Reynolds, Poughkeepsie, contains an excess of corn cob. Nos. 11106, Star Hominy Chop and 11171, Mixed Hominy Chop,—both made by the Miner-Hillard Mill Co. of Wilkesbarre, are mixtures of corn and oat products. These three analyses are therefore excluded from the average.

Guaranties.

The law requires that hominy meal or chop shall be sold with a guaranty of composition.

Twelve of the twenty-seven samples examined were thus sold. The names of these brands, with their guaranties and composition as determined here, are as follows:

No.	Manufacturer or Dealer.	Protein. Found.	Protein. Guaranteed.	Fat. Found.	Fat. Guaranteed.
11013	American Hominy Co., Indianapolis	10.6	10.2	6.4	7.7
11093	Buffalo Cereal Co., Buffalo	10.3	10.5	8.4	8.5
11043	C. M. Cox Co., Boston	10.4	10.0	8.0	7.0
11057	Chapin & Co., Boston	10.1	11.0	6.4	8.0
11125	" " "	10.8	11.0	9.2	8.0
11163	" " "	10.4	11.0	7.9	8.0
11171	Miner-Hillard Mill Co., Wilkesbarre	8.8	9.8	3.9	6.7
11032	Miner-Hillard Mill Co., Wilkesbarre, (steam cooked)	10.0	12.0	6.8	9.0
11067	Miner-Hillard Mill Co., Wilkesbarre, (steam cooked)	10.1	12.0	7.0	9.0
10942	Soper & Co., Boston, Blue Ribbon	10.5	11.4	7.7	9.3
11103	Suffert, Hunt & Co., Decatur	10.1	11.0	8.1	7.7
10966	Patent Cereal Co., Geneva, N.Y.	10.6	11.5	8.8	9.3

The percentages of protein in seven of these samples are a good deal lower than the guaranteed percentages.

As in the case of most of the feeds already discussed, hominy meal contains much less protein and fat this year than was found last year. The average percentages of protein and fat for a number of years have been as follows:—

	1903	1902	1901	1900
No. of analyses	24	26	21	10
Protein, per cent	10.49	11.57	11.35	11.67
Fat, per cent	7.85	8.91	8.54	8.71
Cost per ton	$24.28	28.25	24.45	19.95

A ton of mixed wheat feed contains two hundred and sixty-six pounds of *digestible* protein and seventy-eight pounds of *digestible* fat. A ton of hominy feed contains one hundred and forty-two pounds of *digestible* protein and one hundred and forty-four pounds of *digestible* fat, but cost seventy-three cents a ton more than wheat feed. Yet it has a large sale in this state among dairymen who are trying to make the business pay!

A considerable number of samples of hominy meal have been sent in by individuals for analysis as follows:—

10064. Bought from Coles & Co., Middletown, for $25.00 per ton and sent by H. B. Cornwall of Portland. It contains 10.37 per cent. of protein and is therefore of good quality.

10065. Bought from Herman L. Buss, Boston, for $21.80 per ton in car lots of twenty tons, by H. B. Cornwall, Portland. It contains 10.19 per cent. of protein and is of fair quality.

10067. Sent by Mrs. I. F. Barnard, North Haven, who states that it was bought for white hominy meal of the Coöperative Feed Co., North Haven,and that one horse nearly died of colic after eating it and others refused to eat it. The sample contains more protein than hominy meal contains, 13.31 per cent., but nothing was found to explain the injurious effects noted above.

10544. Sent by Joseph Delehanty, Southington, stated to be Niagara White Meal from Chapin & Co., contains 10.87 per cent. of protein and 7.65 per cent. of fat.

Two samples of Star Hominy, made by the Toledo Elevator Co., Toledo, Ohio, and sold through W. T. Reynolds & Co., Poughkeepsie, were received for analysis.

11206 was sent by J. H. Crowley, Canton Center, who states that he bought it of the Collinsville Grain Co., who stated to him that it came from F. W. Konold of Collinsville.

11214 was sent by L. M. Bristol, Canton Center, who states that it was bought of F. W. Konold. Mr. Konold advises us that it was bought of W. T. Reynolds, Poughkeepsie with a statement of composition of 11.40 per cent. of protein and 7.31 per cent. of fat. The analyses of these samples are as follows:—

	11206	11214
Protein	8.37	8.62
Fiber	10.19	10.41
Fat	6.33	6.46

RYE BRAN, RYE FEED.

Analyses on pages 418-19.

The nine samples represented in the tables are of good quality, free from adulteration and of the usual composition.

MALT SPROUTS, BARLEY SPROUTS.

Analyses on pages 418-19.

Four samples are represented in the table. Three are of good quality and have the usual composition. One of them, 11165, from Hollister, Chase & Co. of New York, sold by Scofield & Miller of Stamford, is distinctly inferior, containing only half the usual percentage of protein. It is also a dirty product, as appears from the high percentage of ash and also from microscopic examination.

It is therefore excluded from the average.

DISTILLERS GRAINS.

Analyses on pages 418-19.

Three of the samples represented in the table are sold under the name of Ajax Flakes ("Manhattan Gluten") by Chapin & Co., Boston. With these is included one sample of Hall's AAAA Distillers Grains having similar composition. All of them are corn products, a dried residue from the manufacture of alcohol. Two samples of the Ajax Flakes and the sample of Hall's Distillers Grains are below their guaranteed composition.

OAT PRODUCTS.

Ground Oats.

Analyses on pages 418-19.

The two samples of ground oats examined are of average quality and free from adulteration.

The price is, however, prohibitive for use as a dairy food.

Oat Feeds.

Analyses on pages 418-21.

These "feeds" are offered for a few dollars less per ton than such standard articles as wheat feeds. Some of them are little more valuable than oat chaff, which, sold under its true name, can be bought for from $7 to $10 per ton. Their analyses are summarized below and compared with oat chaff. No guaranties of composition are given with these goods, as is required by law.

	Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Ether Extract.
Oat Chaff	**7.8**	**7.5**	**5.1**	**28.5**	**49.5**	**1.6**
"Victor" Oat Feed	9.7	4.3	9.2	17.1	56.7	3.0
"Royal" "	8.1	6.3	6.2	25.2	52.4	1.8
"Vim" "	9.5	5.3	7.7	22.8	52.0	2.7
Cox's "	6.7	5.6	6.6	24.2	53.3	3.6
Pillsbury's "	8.1	6.9	7.1	24.8	51.1	2.0

These oat feeds cost from $16 to $23 per ton, an average of about $19.50. Taking the average composition of the five brands, it appears that a ton of oat feed, such as is now offered and sold in Connecticut in large quantity, contains the amounts of food ingredients given below.

There is also given, for comparison, the amounts of food ingredients which can be bought *for the same money* in mixed spring wheat feed.

	A ton of average Oat Feed, costing $19.50, contains pounds.	Mixed Wheat Feed, costing $19.50, contains pounds.
Protein	147	281
Fiber	456	136
Nitrogen-free Extract	1062	894
Fat	52	82

Dollar for dollar, the feeder gets nearly twice as much protein,—the *only* thing which he really needs to buy to piece out his home-grown feeds—in wheat feed, a standard article, than he gets in oat feed, the refuse from oat meal factories. Yet a great deal of oat feed is sold in the state and dairying—with some farmers—"doesn't pay."

MISCELLANEOUS MIXED FEEDS.

Provender.

Analyses on pages 420–21.

The three samples analyzed are of the usual quality.

Corn and Oat Feed.

Analyses on pages 420–23.

"Victor," "XXX," "De-Fi" and "Boss" Corn and Oat Feeds are all mixtures of corn and oat products: the "XXX" and "De-Fi" brands also contain some wheat product. All meet the guaranties of their manufacturers and all contain less protein and considerably more fiber than mixtures of good corn and oats contain.

Schumacher's Stock Feed

Analyses on pages 422–23.

Is a mixture of corn, oat and barley products which contains lower percentages of protein and fat than are guaranteed.

Proprietary Horse Feeds.

Analysis on pages 422–23.

Blomo Feed is stated by the manufacturer to be a mixture of molasses, blood and cereal substance. The same meets the guaranty of the manufacturer.

Buffalo Cereal Co.'s Horse Feed

Analyses on pages 422–23.

Consists of coarsely ground corn, oat and wheat products with a little linseed meal, and meets its guaranty.

H. O. Horse Feed

Analyses on pages 422–23.

Contains coarsely ground corn, oat and wheat and peanut products and meets its guaranty.

Molasses Feed for Horses

Analyses on pages 422–23.

Consists chiefly of malt sprouts, brewers grains and molasses and contains much less protein than is guaranteed.

The prices of these ready mixed feeds, ranging from $20 to $30 per ton, are quite out of proportion to their feeding value.

POULTRY FEEDS.

Analyses on pages 422–25.

The analyses of a number of poultry feeds of vegetable nature as well as of beef scrap and bone and meat meal appear in the table, but do not call for more particular notice.

The vegetable feeds are mixtures of corn, oat and wheat products; linseed meal, cotton seed meal and peanuts are found in some of them.

PROPRIETARY DAIRY AND STOCK FEEDS.

Analyses on pages 424–27.

Here are included eight brands of mixed feeds. Dickinson's Stock Feed, Haskill's Stock Feed, Lenox Stock Feed and Blatchford's Calf Meal do not fully meet the guaranties of the manufacturers.

The Quaker Dairy Feed, made by the American Cereal Co., consists of a mixture of wheat, oat and corn products and cotton seed meal, containing 14.4 per cent. of protein and more than the guaranteed amount.

The Buffalo Cereal Co.'s Dairy Feed is a mixture consisting chiefly of oat and corn products with some wheat product and contains more than the guaranteed amount of protein.

The Creamery Feed of the same company is stated by a representative of the company to be a mixture of cotton seed, hominy, gluten, corn, oats and linseed. This brand contains 20 per cent. of protein as guaranteed.

The H. O. Dairy Feed consists of oat, wheat and corn products, with some cotton seed meal and peanuts.

Blatchford's Calf Meal contains a wheat product, linseed meal, cotton seed meal, carob beans, common beans and fenugreek.

Dickinson's, Haskill's and Lenox Stock Feed consist wholly of corn and oats and contains less protein than either corn or oats of good quality.

The most concentrated of these mixtures contains 24.6 per cent. of protein and the others range between 20.06 and 7.81 per cent. of protein. The prices range from $21.00 to $70.00 per ton, or excluding Blatchford's Calf Meal from $21 to $28.00 per ton.

A mixture of 1000 pounds of gluten feed and 1000 pounds of mixed wheat feed made at home would cost at present retail prices $24.76. It would contain a good deal more protein than could be bought for the same money in any of these factory-mixed feeds and would have a higher feeding value. It would also have this added advantage, that the feeder would know exactly what his animals were eating.

In other words, the cost of most of these factory-mixed feeds is quite out of proportion to their feeding value.

BUCKWHEAT MIDDLINGS.

A single sample, made at the Quinnebaug Mills, Danielson, contains 29.06 per cent. of protein and sells for $22.00 per ton.

"GROUND OIL CAKE COMPOUND."

"Gee's Ground Oil Cake" is not ground oil cake. It consists largely of wheat and weed seeds (black bindweed, foxtail, charlock, linseed), refuse from the screening of wheat.

CONDIMENTAL OR MEDICINAL CATTLE FOODS.

Two samples have been examined. 9909, Sheriden's Condition Powders, sent by F. B. Munson of North Haven, contains linseed meal, charcoal, epsom salts, carbonate of lime, red pepper, ginger, sulphur and probably other constituents.

10152. Pepto Stock Food, made by the Banner Food Co., Auburn, N. Y., contains 23.62 per cent. of protein, being a mixture of linseed meal, wheat middlings, charcoal, fenugreek and salt.

THE DIGESTIBILITY OF FEEDING STUFFS.

A certain part of every feeding stuff is indigestible and passes through the body into the dung without doing anything to sustain the animal. The value of a commercial feed rests wholly in that portion of it which the animal can, under favorable conditions, digest or appropriate and make a part of itself. Some animals have greater power of digestion than others, and the amount of any ingredient, protein, fat or fiber, digested by a given animal depends much on the proportion of other ingredients which are fed along with it. Thus, if starchy matter is fed in too large proportion, a considerable part of it will pass into the dung and be wasted. But fed in proper fashion over 90 per cent. of it may be taken up by the body and nourish it.

Table I gives the "digestion coefficients" of most of the feeds mentioned in Table IV.

The digestion coefficient of protein, for example, in cotton seed meal is 88. This means that in a properly made ration, neat cattle, in good health, may be expected, on the average, to digest about 88 parts out of every 100 parts of the protein of cotton seed meal of good quality. The table has no great mathematical precision, but is, nevertheless, a valuable general guide in feeding.

The use of the table is quite simple. Suppose analysis shows a certain sample of cotton seed meal to contain 43.5 per cent. of protein; that is, 43.5 pounds of protein in 100 pounds of the meal. It is desired to know how much *digestible* protein is contained in 100 pounds of meal. The table of "digestion coefficients" shows that of every 100 pounds of crude protein in cotton seed meal 88 pounds are digestible. It follows by the rule of three (100 is to 88 as 43.5 is to 38.28), that of the 43.5 pounds of protein 38.28 pounds are digestible. To apply the table, multiply the percentage found on analysis by the proper coefficient taken from the table and divide the product by 100. The result will be the percentage amount of *digestible* protein, fiber, etc., as the case may be.

In Table IV, under the averages of analyses, will be found calculated the average digestible nutrients contained in the different feeding stuffs, so far as the data at hand permit.

TABLE I.—DIGESTION COEFFICIENTS, OR PERCENTAGES OF THE FOOD INGREDIENTS, FOUND BY ANALYSES, WHICH ARE DIGESTIBLE BY NEAT CATTLE.

(Jordan's Compilation, Office of Experiment Stations, Bulletin 77.)

	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Cotton Seed Meal	88	56	62	93
Linseed Meal, new process	85	80	86	97
Linseed Meal, old process	89	57	78	89
Corn Meal	68	--	95	92
Gluten Meal	88	--	90	94
Gluten Feed	86	78	89	84
Wheat Bran	78	29	69	68
Wheat Middlings	80	33	81	86
Wheat Mixed Feed	80	25	78	78
Oats*	78	20	76	83
Rye Meal	84	--	92	64
Malt Sprouts	80	33	68	100
Dried Brewers Grains	79	52	58	91
H. O. Dairy Feed	78	41	70	86
H. O. Horse Feed	74	35	79	84
Quaker Oat Feed	81	43	67	89
Quaker Dairy Feed†	78	41	70	86
Victor Corn and Oat Feed‡	71	48	83	87

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* Mentzel and Lengerke. † Assumed same as H. O. Dairy Feed.

‡ Assumed for all other corn and oat feeds.

REGARDING THE PURCHASE OF COMMERCIAL FEEDING-STUFFS.

It needs to be constantly borne in mind that feeding-stuffs are bought to supply a deficiency of protein in those which are usually raised on the farm.

Hay, corn fodder, ensilage and stover form the basis and make up the bulk of the cattle food and should supply all the coarse feed, as well as most of the starch, sugar and fat which are needed.

They are, however, deficient in protein. The feeder's aim then is, or should be, to buy *digestible protein* at as low a price as he can, in forms relished by his stock. He is not in the market to buy mixtures of cattle medicine and food, nor starchy foods, nor woody fiber, nor the many wastes of factories, where so-called "breakfast goods" for human use are made.

It will very rarely pay him to buy anything which contains as little protein as corn meal. Corn meal he can generally raise much more cheaply than he can buy it—and corn meal fed with hay or ensilage needs the addition of some feed *richer in protein,* in order to avoid waste of starchy matter in feeding.

Table II is a list of the commercial feeding-stuffs mentioned in this report, which are used in feeding cows, with the percentages of protein and fat in these feeds, and their average prices, arranged according to the per cent. of protein, the ingredient with which the buyer is chiefly concerned. The table is a practical summary of the analyses to be given in Table IV and deserves careful study.

In this table the average price given with the average composition of each feed is not in most cases the average of the prices quoted by dealers, as these do not in all cases represent ruling market rates. The average price per ton given in Table II is calculated from the market quotations of the week ending January 24th, 1904—for such articles as are quoted in the market reports—by adding in each case $2.00, which represents the average difference between ton and car-lot prices.

This therefore, quite accurately represents the condition of the feed market at the date named and affords a better basis for comparing the prices of feeds than an average of retailers' quotations made at various dates extending over four months' time.

The table shows that we have six distinct groups of feeding-stuffs:

1. Cotton seed meal with over 40 per cent. of protein and costing $28.50 per ton on the average.
2. Linseed and gluten meal and dried distillers grains containing between 30 and 40 per cent. of protein, the prices ranging from $25.75 to $32.00 per ton.
3. Most of the gluten feeds, malt sprouts, buckwheat middlings and Buffalo Cereal Co.'s Creamery Feed, containing from 20 to 30 per cent. of protein, prices ranging from $20.00 to $27.50 per ton.
4. The wheat feeds, H. O. Dairy Feed, and rye feed, having between 15 and 20 per cent. of protein and costing from $21.25 to $28.00 per ton.
5. Lower grade feeds, containing from 14.5 to 10 per cent. of protein, which the feeder of dairy stock need not consider at all in buying protein to balance a ration made up of home-grown fodder, if he has home-grown shelled corn at his disposal. The prices range from $23.75 to $26.00 per ton.
6. Oat refuse and mixtures of corn and oat refuse, containing even less than 10 per cent. of protein but costing from $14.50 to $26.00 per ton.

TABLE II.—COMMERCIAL FEEDS NOW IN THE CONNECTICUT MARKET ARRANGED ACCORDING TO THE PERCENTAGES OF PROTEIN IN THEM.

With more than 40 per cent. of Protein.	Protein per cent.	Fat per cent.	Cost per ton.
Cotton Seed Meal	43.16	9.22	$28.50
With 30 to 40 per cent. of Protein.			
Cream Gluten	37.06	3.27	32.00
Linseed Meal, New Process	36.35	3.17	25.75
" " Old Process	33.05	7.51	26.25
Dried Distillers Grains	32.23	12.09	27.50
With 20 to 30 per cent. of Protein.			
Buckwheat Middlings	29.06	7.77	22.00
Barley Sprouts	27.25	1.56	20.00
Various Gluten Feeds	24.43	3.16	27.50
Buffalo Cereal Co.'s Creamery Feed	20.06	5.38	27.00.

With 15 to 20 per cent. of Protein.	Protein per cent.	Fat per cent.	Cost per ton.
Spring Wheat Middlings	17.88	4.98	23.50
H. O. Dairy Feed	17.49	4.53	28.00
Spring Mixed Feed	16.96	4.96	25.00
Winter Mixed Feed	16.67	4.53	25.00
Winter Wheat Middlings	16.41	4.54	23.50
Spring Wheat Bran	15.85	4.88	23.50
Rye Feed	15.57	3.02	21.25
Winter Wheat Bran	15.52	4.49	24.00
With 10 to 15 per cent. of Protein.			
Buffalo Cereal Co.'s Dairy Feed	14.44	4.69	25.00
Quaker Dairy Feed	14.42	4.05	24.00
Schumacher Stock Feed	11.87	4.69	27.00
Provender	10.62	4.03	23.75
Hominy Feed	10.49	7.85	24.75
With less than 10 per cent. of Protein.			
XXX Corn and Oat Feed	9.66	5.09	25.50
Victor Oat Feed	9.19	3.03	20.00
Lenox Feed	9.06	4.48	23.50
Haskell's Stock Feed	8.87	5.80	24.00
Victor Corn and Oat Feed	8.83	4.02	23.50
De-Fi Corn and Oat Feed	8.81	2.90	27.25
Corn Meal	8.73	3.47	23.50
Boss Corn and Oat Feed	8.66	4.57	24.50
Durham Corn and Oat Feed	8.25	4.30	24.00
Dickinson's Stock Feed	7.81	4.30	22.00
Vim Oat Feed	7.69	2.67	14.50
Pillsbury's Oat Feed	7.06	1.98	23.00
Cox's Oat Feed	6.64	3.60	17.00
Royal Oat Feed	6.19	1.75	20.00

It will also be noticed that the percentages of fat in these feeds are not very unlike. If we except cotton seed meal, old process linseed meal, dried distillers grains, buckwheat middlings and hominy feed, the percentages of fat all fall between 1.6 and 5.8.

It is therefore possible to make a rough comparison of the feeds *taking account of protein alone,* as that is the ingredient which the feeder is chiefly concerned in getting in commercial feeds. Such a comparison shows the following:—

If 20 pounds of Protein in	Cotton Seed Meal costs	$0.66
Then 20 pounds of Protein in	Barley Sprouts, Buckwheat Middlings and Linseed Meal, old or new process, costs	.70–.80
" "	Cream Gluten and Dried Distillers' Grains costs	.80–.90
" "	Gluten Feeds costs	1.00–1.25
" "	Spring Wheat Bran, Winter and Spring Wheat Middlings, Winter and Spring Mixed Feed, Buffalo Cereal Creamery Feed and Rye Feed costs	1.25–1.50
" "	Winter Wheat Bran, H. O. Dairy Feed, Quaker Dairy Feed, Buffalo Cereal Co.'s Dairy Feed, costs	1.50–1.75
" "	Vim Oat Feed costs:	1.75–2.00
" "	Various Oat, and Corn and Oat Feeds and a number of so-called Stock Feeds range in price from	2.00–3.25

The above is a rough but fair statement of the *comparative* cost of protein in these various feeds. No consideration is given to the amounts of starch, sugar and fiber contained in them. These last have a necessary part in the ration, but they are not things which the average dairyman can at all afford to buy, except incidentally, in feeds costing $20 or more per ton. They are things which he can raise cheaply and abundantly on his own farm and must raise rather than buy them to succeed in his business. They come from the air and from the water of the soil and air and do not exhaust the fertility of his land. Protein, on the other hand, is not so easily and abundantly produced in his crops, in concentrated forms, it takes from the land the most expensive and least abundant element of plant food, and its purchase brings to the farm not only the element needed to balance the home-grown feeds in the ration, but also the element which, as a rule, his land most lacks.

The table shows that in feeds containing 15 or more per cent. of protein he buys the latter at prices ranging from 66 cents to $1.75 per "unit," i. e. twenty pounds. In the feeds having less than 15 per cent. of protein he pays from $1.50 to $3.25 for protein and gets it in a form in which it cannot be fed as economically. That large quantities of these low grade feeds are bought and used in Connecticut shows, of itself, that money is lost in the dairy business which could be saved by a little study of the way to use commercial feeding stuffs.

THE WEIGHT OF ONE QUART OF VARIOUS FEEDING-STUFFS.

The following table gives the weight of one quart of the feeds named, and is useful to calculate the weight of grain ration fed, from the measure which is almost universally used on farms.

This table was prepared by Mr. H. G. Manchester of West Winsted.

TABLE III.—THE AVERAGE WEIGHT OF ONE QUART OF EACH OF THE FEEDS NAMED.

BY H. G. MANCHESTER, WEST WINSTED.

	Pounds.
Cotton Seed Meal	1.5
Linseed Meal, old process	1.1
Linseed Meal, new process	0.9
Gluten Meal	1.7
Gluten Feed	1.2
Distillers Grains	0.7
Wheat Bran, coarse	0.5
Wheat Middlings, coarse	0.8
Wheat Middlings, fine	1.1
Mixed Wheat Feed	0.6
Corn Meal	1.5
Hominy Meal	1.3
Provender	1.5
Oats	1.2
Rye Bran	0.6
H. O. Dairy Feed	0.7
Victor Corn and Oat Feed	0.7

TABLE IV.—ANALYSES OF COMMERCIAL FEEDS.

Station No.	Name of Feed.	Manufacturer or Jobber.	Retail Dealer.
	Cotton Seed Meal.		
11139	A B C brand	The Augusta Brokerage Co., Augusta, Ga.	Suffield, Spencer Bros.
11042		American Cereal Co., Chicago	Southington, Southington Lumber and Feed Co.
11076	England Mill	American Cotton Oil Co., New York	Wallingford, E. E. Hall
11051	Jackson Mill	American Cotton Oil Co., New York	Collinsville, F. W. Konold
10969	Trenton, Tenn. Mill	American Cotton Oil Co., New York	Jewett City, J. E. Leonard & Son
10958		R. W. Biggs, Memphis, Tenn.	Yantic, A. R. Manning & Co.
10984	Canary brand	R. W. Biggs, Memphis, Tenn.	New Haven, R. G. Davis
11089	“ “	R. W. Biggs & Co., Memphis, Tenn.	Hamden, Ira W. Beers
11105	Dixie brand	Humphreys, Godwin & Co., Memphis, Tenn.	Berlin, J. C. Lincoln
10957	Green Diamond brand	Chapin & Co., St. Louis, Mo.	Yantic, A. R. Manning & Co.
11019	“ “	Chapin & Co., St. Louis, Mo.	New Haven, Abner Hendee
11062	“ “	Chapin & Co., St. Louis, Mo.	Bristol, Geo. W. Eaton
11131	“ “	Chapin & Co., St. Louis, Mo.	Hartford, Smith, Northam & Co.
10983	H. & H. brand*	Hayley & Hoskins, Memphis, Tenn.	Putnam, Bosworth Bros.
11135		Hunter Bros., St. Louis, Mo.	Hartford, Daniels Mill Co.
11045	Magnolia brand	Chas. M. Cox Co., Boston	Plainville, F. B. Newton
11056	“ “	Chas. M. Cox Co., Boston	Collinsville, Collinsville Grain Co.
10949	Old Gold brand	T. H. Bunch, Little Rock, Ark.	New London, Arnold Rudd & Co.
10950		Planters Cotton Oil Co., Montgomery, Ala.	New London, E. H. Caulkins
11108		J. E. Soper & Co., Boston	New Britain, The C. W. Lines Co.
10945	Star brand	Sledge & Wells Co., Memphis, Tenn.	Groton, Groton Grain Co.
10948	“	Sledge & Wells Co., Memphis, Tenn.	New London, Arnold Rudd & Co.
11155	Sunflower brand	J. G. Falls & Co., Memphis, Tenn.	Willimantic, H. A. Bugbee
11074	“ “	American Cereal Co., Chicago	Wallingford, E. E. Hall
11227	“ “	American Cereal Co., Chicago	Waterbury, The Platt Mill Co.
			Average of the 25 analyses.
			Average digestible

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* See note, page 376.

SAMPLED IN 1903.

Station No.	ANALYSES.						Price per ton.
	Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract.	
11139	8.80	6.13	41.69	7.74	27.07	8.57	$29.00
11042	10.39	6.05	41.44	7.99	26.34	7.79	29.00
11076	10.50	7.31	41.50	8.18	23.33	9.18	28.00
11051	10.35	6.63	45.25	5.30	23.17	9.30	30.00
10969	9.43	7.25	47.12	4.92	22.65	8.63	29.00
10958	9.33	5.90	42.12	8.41	26.80	7.44	28.00
10984	9.32	7.30	41.12	8.34	22.60	11.32	28.00
11089	9.25	7.21	42.50	6.82	23.52	10.70	29.00
11105	9.80	6.93	42.69	7.52	24.16	8.90	30.00
10957	9.83	6.75	46.25	5.30	23.22	8.65	28.00
11019	9.21	6.07	41.94	7.45	26.50	8.83	30.00
11062	9.48	7.50	46.75	4.51	23.02	8.74	29.00
11131	7.02	6.11	41.87	8.60	28.07	8.33	29.00
10983	8.22	6.92	37.50	9.89	24.50	12.97	29.00
11135	7.70	7.62	45.06	5.71	22.63	11.28	29.00
11045	10.13	6.22	44.25	5.87	23.74	9.79	30.00
11056	10.15	5.97	45.44	6.25	23.82	8.37	30.00
10949	8.94	7.68	43.62	5.52	24.46	9.78	29.00
10950	8.98	6.18	48.19	5.54	22.46	8.65	29.00
11108	10.02	7.10	45.56	5.68	23.79	7.85	29.00
10945	9.42	7.27	44.50	5.26	22.68	10.87	30.00
10948	9.47	5.85	42.12	8.36	25.89	8.31	29.00
11155	9.45	5.66	41.87	8.02	25.88	9.12	29.00
11074	10.46	5.63	38.56	9.67	26.54	9.14	29.00
11227	8.79	5.79	40.31	9.33	27.64	8.14	28.00
	9.38	**6.60**	**43.16**	**7.05**	**24.59**	**9.22**	**29.04**
	----	----	37.98	3.95	15.00	8.57	

TABLE IV.—*Continued.* ANALYSES OF COMMERCIAL FEEDS.

Station No.	Name of Feed.	Manufacturer or Jobber.	Retail Dealer.
	Linseed Meal, New Process.		
10952	Cleveland Flaxmeal	American Linseed Co., Chicago, Ill.	Yantic, A. R. Manning & Co.
11017	Linseed Meal	American Linseed Co., Chicago, Ill.	Guilford, F. H. Rolf
			Guaranty
			Average of these 2 analyses
			Average digestible
	Linseed Meal, Old Process.		
10990		American Linseed Co., New York	New Haven, R. G. Davis
11022		American Linseed Co., New York	New Haven, Abner Hendee
11241	Export brand	Chapin & Co., Boston	Torrington, E. H. Talcott
10937	Green Oval brand	Flint Mill Co., Milwaukee	So. Norwalk, M. T. Hatch
10951		Hauenstein & Co., Buffalo, N. Y.	New London, E. H. Caulkins
11117		Hunter Bros., St. Louis, Mo.	New Britain, Hugh Reynolds
11133		Metzger Seed and Oil Co., Toledo, Ohio	Hartford, Smith, Northam & Co.
11070		Midland Linseed Co., Minneapolis	Bristol, W. O. Goodsell
11172	Ground Linseed Cake	Midland Linseed Co., Minneapolis	Bridgeport, Wm. M. Terry & Co.
			Average of these 9 analyses
	WHEAT PRODUCTS.		Average digestible
	Bran from Winter Wheat.		
11004	Bran	American Cereal Co., Chicago	Branford, S. V. Osborn
11016	"	American Cereal Co., Chicago	Guilford, F. H. Rolf
10947	" ◇	Chapin & Co., Boston	New London, Beebe & Bragaw
11087	"	James Goldie Co., Canada	Hamden, Ira W. Beers
11038	"	Hecker-Jones-Jewell Milling Co., N. Y.	Southington, Southington Lumber & Feed Co.
10996	" Kansas "C"		New Haven, The J. T. Benham Est.
10972	" U. S. A.		Danielson, Waldo Bros.
			Average of the 6 analyses*.
			Average digestible
	Bran from Spring Wheat.		
10964	Bran	Bay State Mill Co., Winona, Minn.	Norwich, A. A. Beckwith
11086	"	Cataract Milling Co., Niagara Falls	Hamden, Ira W. Beers
11182	"	L. Christian & Co., Minneapolis	Derby, Peterson-Hendee Co.
11236	"	J. G. Davis & Co., Rochester, N. Y.	Winsted, Balch & Platt

* Excluding 11087.

SAMPLED IN 1903.

Station No.	Analyses.						Price per ton.
	Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract.	
10952	10.18	5.22	36.44	8.73	36.15	3.28	$30.00
11017	11.04	5.09	36.25	9.17	35.38	3.07	35.00
	----	----	**37.5**	----	----	**1.0**	----
	10.61	**5.15**	**36.35**	**8.95**	**35.77**	**3.17**	**32.50**
	----	----	**30.90**	**7.16**	**30.76**	**3.07**	----
10990	11.56	5.12	32.37	8.73	34.90	7.32	27.00
11022	11.21	5.36	33.50	8.81	34.12	7.00	35.00
11241	9.68	5.82	31.44	9.26	36.56	7.24	32.00
10937	10.25	4.86	36.56	7.68	33.34	7.31	34.00
10951	11.19	4.77	34.06	7.94	34.98	7.06	28.00
11117	10.95	5.12	31.19	9.42	35.89	7.43	30.00
11133	10.85	4.96	31.75	9.12	36.07	7.25	31.00
11070	10.52	4.92	33.94	8.24	33.89	8.49	30.00
11172	9.61	5.53	32.62	8.01	35.70	8.53	30.00
	10.65	**5.16**	**33.05**	**8.58**	**35.05**	**7.51**	**30.77**
	----	----	**29.41**	**4.89**	**27.34**	**6.68**	----
11004	11.20	5.90	14.81	7.84	55.81	4.44	23.00
11016	11.20	5.98	16.87	7.49	53.56	4.90	23.00
10947	10.72	5.84	15.69	9.61	53.15	4.99	23.00
11087	11.84	5.89	12.81	10.10	55.15	4.21	23.00
11038	11.47	6.68	15.06	10.19	52.31	4.29	23.00
10996	10.85	6.66	15.56	9.19	53.61	4.13	----
10972	10.70	5.91	15.12	7.92	55.86	4.49	----
	11.14	**6.12**	**15.52**	**8.91**	**54.21**	**4.49**	**23.00**
	----	----	**12.10**	**2.58**	**37.40**	**3.05**	----
10964	10.53	6.99	16.06	10.54	51.15	4.73	24.00
11086	11.30	5.62	16.25	9.09	52.54	5.20	21.00
11182	10.31	5.85	16.25	9.70	53.00	4.89	23.00
11236	9.98	5.55	16.12	9.50	53.66	5.19	24.00

TABLE IV.—*Continued.* ANALYSES OF COMMERCIAL FEEDS.

Station No.	Name of Feed.	Manufacturer or Jobber.	Retail Dealer.
	Bran from Spring Wheat.		
11090	Bran, Clover Leaf	Gardner Mill, Hastings, Minn.	Meriden, S. A. Billings
10974	" Commander	Gregory, Cook & Co., Duluth, Minn.	Danielson, Young Bros. Co.
11099	" Duluth Imperial	Imperial Milling Co , Duluth, Minn.	Meriden, A. H. Cashen
10995	" Independence	New York Milling Co., New York	New Haven, J. T. Benham Est.
11009	" Superior	Lake Superior Mills, Superior, Wis.	Guilford, Geo. F. Walter
10953	"	Missouri Valley Milling Co., Mandan, No. Dak.	Yantic, A. R. Manning & Co.
11034	"	The Northwestern Con. Milling Co., Minneapolis	Plantsville, T. B. Atwater
11109	"	Pillsbury, Minneapolis, Minn.	New Britain, C. W. Lines Co.
11143	"	Pillsbury, Minneapolis, Minn.	Suffield, Arthur Sikes
11119	"	Porter Milling Co., Winona, Minn.	East Hartford, G. M. White & Co.
11041	"	Washburn-Crosby Co., Minneapolis, Minn.	Southington, Southington Lumber & Feed Co.
11178	" Jersey	Geo. C. Christian, Minneapolis, Minn.	Bridgeport, Berkshire Mills
			Average of these 16 analyses
			Average digestible
	Middlings, Winter Wheat.		
11005	Middlings	American Cereal Co., Chicago	Branford, S. V. Osborn
11015	"	American Cereal Co., Chicago	Guilford, F. H. Rolf
10954	"	C. M. Cox Co., Boston	Yantic, A. R. Manning & Co.
10962	"	J. Hale & Co., Lyons, Mich.	Norwich, A. A. Beckwith
10999	" H	Hecker-Jones-Jewell Co., New York	East Haven, Hawkins & Forbes
11039	" H	Hecker-Jones-Jewell Co., New York	Southington, Southington Lumber & Feed Co.
11020	" M	Hecker-Jones-Jewell Co., New York	New Haven, Abner Hendee
11083	" M	Hecker-Jones-Jewell Co., New York	North Haven, Co-op. Feed Co.
10961	"	A. H. Randall Mill Co., Tekonsha, Mich.	Norwich, Norwich Grain Co.
10992	"	F. Thoman & Bro., Lansing, Mich.	New Haven, R. G. Davis
10973	" U. S. A.		Danielson, Waldo Bros.
11247	" T		Litchfield, Marsh & Newcomb
			Average of these 12* analyses
			Average digestible

* Excluding No. 10961.

SAMPLED IN 1903.

Station No.	Analyses.						Price per ton.
	Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract.	
11090	10.42	6.94	15.12	11.46	51.66	4.40	$24.00
10974	10.33	6.63	15.44	11.30	51.30	5.00	22.00
11099	10.95	5.76	16.00	9.12	53.12	5.05	23.00
10995	12.24	6.68	15.25	9.44	52.61	3.78	23.00
11009	11.12	5.18	16.87	8.32	53.43	5.08	21.00
10953	10.60	5.85	16.44	8.96	52.52	5.63	21.00
11034	11.50	6.65	15.37	11.00	50.73	4.75	24.00
11109	10.57	6.72	15.69	11.25	50.85	4.92	22.00
11143	11.05	5.94	15.62	9.82	52.52	5.05	21.00
11119	10.10	6.70	15.87	10.84	51.64	4.85	21.00
11041	11.35	6.22	16.00	10.60	51.23	4.60	22.00
11178	9.38	6.88	15.25	12.20	51.30	4.99	24.00
	10.74	**6.26**	**15.85**	**10.19**	**52.08**	**4.88**	**22.50**
	----	----	**12.36**	**2.96**	**35.94**	**3.32**	----
11005	11.97	4.47	16.37	5.90	56.29	5.00	27.00
11015	11.33	2.41	16.50	2.58	63.53	3.65	29.00
10954	11.29	3.87	17.94	4.78	57.41	4.71	27.00
10962	12.66	3.10	15.31	3.19	61.69	4.05	27.00
10999	11.02	5.47	16.44	7.42	55.02	4.63	21.00
11039	9.97	5.05	16.37	8.96	54.96	4.69	23.00
11020	10.05	4.85	16.12	9.14	55.31	4.53	27.00
11083	11.38	4.66	16.44	7.76	55.63	4.13	24.00
10961	12.18	2.79	12.62	3.32	65.20	3.89	27.00
10992	12.94	3.10	15.19	3.49	61.08	4.20	25.00
10973	11.73	4.37	15.87	5.40	57.59	5.04	----
11247	9.85	4.93	18.00	7.24	54.68	5.30	25.00
	11.29	**4.21**	**16.41**	**5.99**	**57.56**	**4.54**	**25.55**
	----	----	**13.13**	**1.98**	**46.62**	**3.90**	----

TABLE IV.—*Continued.* ANALYSES OF COMMERCIAL FEEDS.

Station No.	Name of Feed.	Manufacturer or Jobber.	Retail Dealer.
	Middlings, unclassified.		
11044	Middlings	Caledonia, N. Y.	Plainville, F. B. Newton
10943	"	C. W. Campbell & Co., Westerly, R. I.	Stonington, S. H. Chesebro
11073	" White Mountain Cream	G. E. Gee Grain Co., Minneapolis, Minn.	Bristol, W. O. Goodsell
	Middlings, Spring Wheat.		
11049	Middlings	Brooks, Minneapolis, Minn.	Collinsville, F. W. Konold
11088	" Niagara white	Cataract City Milling Co., Niagara Falls	Hamden, Ira W. Beers
11238	" Snowball flour	The Gardner Mill, Hastings, Minn.	Winsted, Balch & Platt
11031	"	Abner Hendee, New Haven	Avon, J. & H. Woodford
11101	" <•>	Imperial Milling Co., Duluth, Minn.	Meriden, A. H. Cashen
11008	" Superior	Lake Superior Mills, Superior, Wis.	Guilford, Geo. F. Walter
11136	" Colonial	Miner-Hillard Mill Co., Wilkesbarre, Pa.	Hartford, Daniels Mill Co.
10971	" Standard	New Prague Milling Co., New Prague, Minn.	Danielson, Waldo Bros.
11052	" "	New Prague Milling Co., New Prague, Minn.	Collinsville, Collinsville Grain Co.
11036	" Manhattan	New York City Milling Co., New York	Plantsville, T. B. Atwater
11167	" Red Dog	New York City Milling Co., New York	Stamford, Scofield & Miller
11142	" A	Pillsbury, Minneapolis, Minn.	Suffield, Arthur Sikes
11132	" B	Pillsbury, Minneapolis, Minn.	Hartford, Smith, Northam & Co.
11118	"	Porter Milling Co., Winona, Minn.	East Hartford, G. M. White & Co.
11075	"	Sheffield Milling Co., Minneapolis	Wallingford, E. E. Hall
11166	"	Sheffield Milling Co., Minneapolis	Stamford, Scofield & Miller
11066	"	Thornton & Chester Mill Co., Buffalo	Bristol, Geo. W. Eaton
11177	" Snow's Cream	E. S. Woodworth & Co., Minneapolis	Bridgeport, Berkshire Mills
			Average of these 17* analyses
			Average digestible
	Mixed Feed from Winter Wheat.		
11134	Mixed Feed, Acme	Acme Milling Co., Indianapolis, Ind.	Hartford, Daniels Mill Co.
11100	" Buckeye	American Cereal Co., Chicago	Meriden, A. H. Cashen
11168	" "	American Cereal Co., Chicago	Stamford, Scofield & Miller

* Excluding No. 11136.

SAMPLED IN 1903.

Station No.	Analyses.						Price per ton.
	Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract.	
11044	12.68	3.62	17.06	4.31	57.68	4.65	$26.00
10943	11.72	4.86	17.37	7.83	53.34	4.88	26.00
11073	11.67	3.43	19.69	3.31	56.77	5.13	26.00
11049	11.75	4.71	17.50	7.40	53.65	4.99	26.00
11088	11.22	4.05	16.94	6.38	56.20	5.21	26.00
11238	9.78	5.12	18.12	7.35	54.59	5.04	27.00
11031	10.90	4.68	18.62	7.43	52.40	5.97	24.00
11101	11.04	4.40	17.31	7.98	54.04	5.23	23.00
11008	11.21	4.32	18.06	7.84	53.28	5.29	23.00
11136	10.15	3.53	14.06	5.33	61.20	5.73	27.00
10971	11.29	4.77	19.12	7.30	52.45	5.07	24.00
11052	12.35	4.85	18.31	8.31	50.93	5.25	25.00
11036	12.24	4.85	19.25	7.35	51.38	4.93	24.00
11167	10.60	3.56	17.69	3.70	59.58	4.87	29.00
11142	12.32	4.12	17.81	6.49	54.65	4.61	26.00
11132	10.82	5.16	16.00	9.74	53.20	5.08	23.00
11118	11.45	4.23	17.62	8.91	53.14	4.65	22.00
11075	12.15	4.42	18.44	5.76	54.73	4.50	28.00
11166	11.13	4.02	17.56	5.00	57.86	4.43	28.00
11066	12.39	3.93	16.19	4.74	57.79	4.96	27.00
11177	11.31	3.60	19.37	2.96	58.14	4.62	28.00
	11.41	**4.40**	**17.88**	**6.74**	**54.59**	**4.98**	**25.50**
	----	----	**14.30**	**2.22**	**44.22**	**4.28**	----
11134	10.65	5.65	17.75	7.50	53.92	4.53	24.00
11100	11.37	5.25	16.37	7.15	55.16	4.70	24.00
11168	10.65	5.15	16.44	6.92	56.03	4.81	24.00

TABLE IV.—*Continued.* ANALYSES OF COMMERCIAL FEEDS.

Station No.	Name of Feed.	Manufacturer or Jobber.	Retail Dealer.
	Mixed Feed from Winter Wheat.		
11246	Mixed Feed, Buckeye	American Cereal Co., Chicago	Litchfield, Marsh & Newcomb
11084	" "E"		Hamden, Ira W. Beers
11046	" Berkshire		Plainville, F. B. Newton
10956	"	Blish Milling Co., Seymour, Ind.	Yantic, A. R. Manning & Co.
11115	"	Blish Milling Co., Seymour, Ind.	New Britain, Hugh Reynolds
11245	" No. 32	Chapin & Co., Boston	Litchfield, Marsh & Newcomb
11095	" Crown	Empire Mills, Hannibal, Mo.	Meriden, Meriden Grain & Feed Co.
11138	" Erie		Suffield, Spencer Bros.
11161	" Hoosier	Geo. T. Evans, Indianapolis, Ind.	Colchester, E. F. Strong
11249	" Berkshire	R. J. Hardy & Sons, Boston	Washington, Washington Feed & Supply Co.
11012	"	Isaac Harter, Toledo, Ohio	Guilford, Geo. F. Walter
10970	" Queen	Hecker-Jones-Jewell Co., New York	Danielson, Waldo Bros.
10986	" "	Hecker-Jones-Jewell Co., New York	New Haven, R. G. Davis
11053	" Manhattan	Hecker-Jones-Jewell Co., New York	Collinsville, Collinsville Grain Co.
11078	" "	Hecker-Jones-Jewell Co., New York	North Haven, Co-op. Feed Co.
10967	" Sunshine	Hunter Bros., St. Louis, Mo.	Jewett City, J. E. Leonard & Son
11127	" "	Hunter Bros., St. Louis, Mo.	Hartford, Smith, Northam & Co.
11014	"	Kehlor Bros., St. Louis, Mo.	Guilford, Morse & Landon
10965	" Snowflake	Lawrenceburg Mill Co., Lawrenceburg, Ind.	Norwich, A. A. Beckwith
11104	" "	Lawrenceburg Mill Co., Lawrenceburg, Ind.	Berlin, J. C. Lincoln
11063	" Ideal	Chas. R. Lull, Milwaukee, Wis.	Bristol, Geo. W. Eaton
11068	"	Chas. R. Lull, Milwaukee, Wis.	Bristol, Geo. W. Eaton
11110	" King	R. P. Moore Milling Co., Princeton, Ind.	New Britain, C. W. Lines Co.
11081	" National		North Haven, Co-op. Feed Co.
11120	"	M. Neal, Massilon, Ohio	East Hartford, G. M. White & Co.
11250	"	N. M. Co., Noblesville, Ind.	Washington, Washington Feed & Supply Co.
11169	"	N. M. Co., Noblesville, Ind.	New Canaan, C. H. Fairty
10939	"	Rex Mill Co., Kansas City	So. Norwalk, M. T. Hatch

SAMPLED IN 1903.

Station No.	Analyses.						Price per ton.
	Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract.	
11246	10.40	5.12	16.00	6.99	56.59	4.90	$23.00
11084	11.32	5.92	17.37	8.16	52.83	4.40	22.50
11046	12.13	4.70	17.69	6.49	54.26	4.73	24.00
10956	10.56	5.65	17.94	5.72	55.19	4.94	24.00
11115	10.87	5.88	15.87	7.38	55.65	4.35	23.00
11245	9.69	5.98	17.50	7.44	55.10	4.29	22.50
11095	11.02	5.75	16.62	7.63	54.43	4.55	24.00
11138	11.20	5.70	16.62	7.31	54.74	4.43	24.00
11161	10.40	5.74	15.56	7.19	56.41	4.70	25.00
11249	10.28	5.40	17.00	7.92	55.02	4.38	24.50
11012	11.40	5.93	15.69	7.64	54.76	4.58	24.00
10970	10.37	5.95	15.81	9.38	53.79	4.70	24.00
10986	11.69	6.18	15.62	8.79	53.09	4.63	22.00
11053	11.66	5.42	16.37	7.50	54.52	4.53	25.00
11078	11.55	5.34	16.12	7.90	54.51	4.58	23.00
10967	10.66	5.64	16.87	6.79	55.60	4.44	24.00
11127	10.55	5.84	15.31	7.63	56.10	4.57	24.00
11014	10.85	5.59	18.12	6.73	54.61	4.10	24.00
10965	10.74	5.65	16.06	7.04	55.69	4.82	24.00
11104	10.33	5.65	15.75	6.80	56.84	4.63	24.00
11063*	11.19	4.62	14.94	11.76	54.04	3.45	23.00
11068	10.77	5.73	18.12	8.18	52.31	4.89	23.00
11110	10.57	5.87	18.56	7.75	52.50	4.75	23.00
11081	11.57	5.48	17 56	6.98	54.13	4.28	24.00
11120	11.42	5.06	16.25	6.60	56.24	4.43	23.00
11250	10.03	5.76	16.00	6.84	56.42	4.95	23.00
11169	10.60	5.62	17.81	7.16	54.47	4.34	23.00
10939	10.69	5.78	17.00	7.88	54.03	4.62	23.00

* See note on page 380.

TABLE IV.—*Continued.* ANALYSES OF COMMERCIAL FEEDS.

Station No.	Name of Feed.	Manufacturer or Jobber.	Retail Dealer.
	Mixed Feed from Winter Wheat.		
11003	Mixed Feed	Rex Mill Co., Kansas City	Branford, S. V. Osborn
11111	"	Sparks Milling Co., Alton, Ill.	New Britain, C. W. Lines Co.
11252	"	Sparks Milling Co., Alton, Ill.	Washington, Washington Feed & Supply Co.
10982	" Marine Star	Valier & Spies Milling Co., St. Louis, Mo.	Putnam, Bosworth Bros.
11152	" Farmers' Favorite	Valley City Mill Co., Grand Rapids, Mich.	Willimantic, E. A. Buck & Co.
11158	" Farmers' Favorite	Valley City Mill Co., Grand Rapids, Mich.	Stafford, E. C. Dennis
10955	" Vermont		Yantic, A. R. Manning & Co.
			Average of the 37† analyses
			Average digestible
	Mixed Feed, unclassified.		
10975	Mixed Feed, <▼>	Chapin & Co., Boston	Danielson, Young Bros. Co.
11154	" Ozark	Chapin & Co., Boston	Willimantic, H. A. Bugbee
11153	" A. M. C. Booth	Crosby & Co., Brattleboro, Vt.	Willimantic, E. A. Buck & Co.
11037	" W. S. M.	Abner Hendee, New Haven	Southington, Southington Lumber & Feed Co.
11157	" Ben Hur	Royal Milling Co., Minneapolis	Stafford, E. C. Dennis
11243	"	Simpson, Hendee & Co., New York	Thomaston, L. E. Blackmer
11033	"	Smith, Northam & Co., Hartford	Plantsville, T. B. Atwater
11029*	" Blue Grass	A. Waller & Co., Henderson, Ky.	Avon, J. & H. Woodford
11237*	"		Winsted, Balch & Platt
	Mixed Feed from Spring Wheat.		
10979	Mixed Feed, Bay State	Bay State Milling Co., Winona, Minn.	Danielson, Quinnebaug Store
11048	" Royal	Brooks Elevator Co., Minneapolis, Minn.	Collinsville, F. W. Konold
11256	" "	Brooks Elevator Co., Minneapolis, Minn.	Plainville, Geo. W. Eaton.
11239	" Kent	Chapin & Co., Boston	Torrington, R. W. Jennings
11228	" Columbia	C. M. Cox Co., Boston	Danbury, F. C. Benjamin & Co.
10976	" Samoset	C. M. Cox Co., Boston	Danielson, Young Bros. Co.
11094	" Diamond	Diamond Milling Co., Grand Forks, N. Dak.	Meriden, Meriden Grain & Feed Co.
11232	" "	Diamond Milling Co, Grand Forks, N. Dak.	Danbury, F. C. Benjamin & Co.

* See notice on page 380.

† Excluding No. 11063.

SAMPLED IN 1903.

Station No.	Analyses.						Price per ton.
	Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract.	
11003	11.05	5.53	16.81	7.35	54.69	4.57	$23.00
11111	10.27	5.63	17.25	7.30	55.02	4.53	23.00
11252	9.74	6.15	16.62	7.73	55.44	4.32	22.50
10982	11.13	5.41	15.94	9.13	53.84	4.55	23.00
11152	11.15	5.23	15.37	7.10	56.51	4.64	24.00
11158	11.67	5.09	15.37	6.54	57.04	4.29	24.00
10955	10.44	5.25	17.81	6.98	55.28	4.24	24.00
	10.85	**5.58**	**16.67**	**7.40**	**54.97**	**4.53**	**23.55**
	----	----	**13.34**	**2.44**	**44.53**	**3.90**	----
10975	11.18	6.25	17.19	7.11	53.15	5.12	24.00
11154	10.67	5.70	17.37	7.07	54.61	4.58	23.00
11153	11.38	4.32	20.69	6.24	53.04	4.33	25.00
11037	11.73	5.16	17.50	7.38	54.10	4.13	23.00
11157	10.82	5.13	18.00	7.35	53.21	5.49	24.00
11243	9.59	5.85	17.19	7.75	55.39	4.23	24.00
11033	11.54	5.25	17.31	6.86	54.68	4.36	24.00
11029	11.46	3.96	12.19	13.85	55.77	2.77	22.00
11237	9.56	4.88	14.44	13.52	54.47	3.13	24.00
10979	11.28	5.80	18.06	8.74	50.96	5.16	24.00
11048	12.50	4.66	15.62	8.21	54.31	4.70	24.00
11256	9.76	5.20	15.00	9.85	55.88	4.31	23.00
11239	9.11	6.22	17.19	8.85	54.08	4.55	24.00
11228	10.13	5.52	16.37	7.96	54.46	5.56	22.00
10976	11.17	5.20	17.56	8.47	52.97	4.63	23.00
11094	12.15	4.80	16.62	7.56	53.97	4.90	24.00
11232	9.67	4.93	18.12	8.02	53.95	5.31	22.00

TABLE IV.—*Continued.* ANALYSES OF COMMERCIAL FEEDS.

Station No.	Name of Feed.	Manufacturer or Jobber.	Retail Dealer.
	Mixed Feed from Spring Wheat.		
11240	Mixed Feed	Humboldt Mill Co., Minneapolis, Minn.	Torrington, R. W. Jennings
11229	" Boston	Imperial Milling Co., Duluth, Minn.	Danbury, F. C. Benjamin & Co.
11255	" Monogram	Imperial Milling Co., Minneapolis, Minn.	Plainville, Geo. W. Eaton
11035	" Fancy	Pillsbury, Minneapolis, Minn.	Plantsville, T. B. Atwater
11234	" "	Pillsbury, Minneapolis, Minn.	New Milford, F. R. Green
11162	" Angola	Simpson, Hendee & Co., New York	Colchester, E. F. Strong
11040	"	Thornton & Chester Milling Co., Buffalo, N. Y.	Southington, Southington Lumber & Feed Co.
11065	"	Thornton & Chester Milling Co., Buffalo, N. Y.	Bristol, Geo. W. Eaton
11085	"	Thornton & Chester Milling Co., Buffalo, N. Y.	Hamden, Ira W. Beers
11113	" Superior	Washburn-Crosby Co., Minneapolis	New Britain, C. W. Lines Co.
			Average of these 18 analyses
			Average digestible
	MAIZE PRODUCTS.		
	Corn Meal.		
11107	Meal	Buffalo Cereal Co., Buffalo, N. Y.	Berlin, J. C. Lincoln
11059	"	Collinsville Grain Co., Collinsville	Collinsville, Collinsville Grain Co.
10940	"	Daniels Mill Co., Hartford	Saybrook, J. H. Day, Jr.
			Average of these 3 analyses
			Average digestible
11130	Bran	Smith, Northam & Co., Hartford	Hartford, Smith, Northam & Co.
	Gluten Meal.		
11126	Cream Gluten Meal	Illinois Sugar Refining Co., Chicago, Ill.	Hartford, Smith, Northam & Co.
11137	" " "	Illinois Sugar Refining Co., Chicago, Ill.	Hartford, Daniels Mill Co.
11151	" " "	Illinois Sugar Refining Co., Chicago, Ill.	Putnam, Bosworth Bros.
			Guaranty
			Average of these 3 analyses
			Average digestible
	Gluten Feed.		
10994	Buffalo Gluten Feed	Glucose Sugar Refining Co., Chicago, Ill.	New Haven, J. T. Benham Est.
11000	" " "	Glucose Sugar Refining Co., Chicago, Ill.	East Haven, Hawkins & Forbes

SAMPLED IN 1903.

Station No.	Analyses.						Price per ton.
	Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract.	
11240	10.46	5.22	18.00	7.91	53.16	5.25	$24.00
11229	10.58	5.00	16.87	8.36	54.73	4.46	22.00
11255	9.73	4.93	18.31	7.18	54.64	5.21	24.00
11035	11.66	4.59	17.25	6.89	54.93	4.68	24.00
11234	10.23	5.26	17.81	6.98	54.58	5.14	26.00
11162	10.41	5.47	15.62	10.00	53.80	4.70	25.00
11040	11.12	5.08	16.25	8.37	54.20	4.98	23.00
11065	11.32	5.41	16.44	8.17	53.44	5.22	23.00
11085	11.38	5.35	16.87	8.41	52.88	5.11	22.50
11113	10.86	4.98	17.37	7.82	53.61	5.36	24.00
	10.75	**5.20**	**16.96**	**8.21**	**53.92**	**4.96**	**23.53**
	----	----	**13.57**	**2.05**	**42.06**	**3.87**	----
11107	13.57	1.05	8.19	1.09	73.18	2.92	25.00
11059	13.97	1.28	9.00	1.68	70.29	3.78	25.00
10940	13.39	1.27	9.00	2.15	70.47	3.72	26.00
	13.64	**1.20**	**8.73**	**1.64**	**71.32**	**3.47**	**25.33**
	----	----	**5.94**	----	**67.75**	**3.19**	----
11130	10.77	2.90	11.31	8.26	58.94	7.82	20.00
11126	12.05	0.56	35.94	1.18	48.49	1.78	32.00
11137	12.07	0.73	37.19	1.40	46.98	1.63	32.00
11151	9.55	0.75	38.06	1.17	44.08	6.39	32.00
	----	---	**34.12**	----	---	**3.2**	----
	11.22	**0.68**	**37.06**	**1.25**	**46.52**	**3.27**	**32.00**
	----	----	**32.61**	----	**48.87**	**3.07**	----
10994	10.18	2.67	24.37	5.92	53.69	3.17	25.00
11000	10.69	1.21	24.81	8.13	52.51	2.65	25.00

TABLE IV.—*Continued.* ANALYSES OF COMMERCIAL FEEDS.

Station No.	Name of Feed.	Manufacturer or Jobber.	Retail Dealer.
	Gluten Feed, Continued.		
11006	Buffalo Gluten Feed	Glucose Sugar Refining Co., Chicago, Ill.	Branford, S. V. Osborn
11175	“ “ “	Glucose Sugar Refining Co., Chicago, Ill.	Bridgeport, Standard Feed Co.
11080	“ “ “	Glucose Sugar Refining Co., Chicago, Ill.	North Haven, Co-op. Feed Co.
11198	“ “ “	Glucose Sugar Refining Co., Chicago, Ill.	Meriden, Meriden Grain & Feed Co.
10748	“ “ “	Glucose Sugar Refining Co., Chicago, Ill.	New Haven, R. G. Davis
11203	“ “ “	Glucose Sugar Refining Co., Chicago, Ill.	New London, Beebe & Bragaw
11201	“ “ “	Glucose Sugar Refining Co., Chicago, Ill.	Plainville, G. W. Eaton
11199	“ “ “	Glucose Sugar Refining Co., Chicago, Ill.	Southington, Southington Lumber & Feed Co.
11196	“ “ “	Glucose Sugar Refining Co., Chicago, Ill.	Wallingford, E. E. Hall
10749	“ “ “	Glucose Sugar Refining Co., Chicago, Ill.	Westville, W. E. Warner & Bro.
11261	“ “ “	Glucose Sugar Refining Co., Chicago, Ill.	Willimantic, H. A. Bugbee
11197	“ “ “	Glucose Sugar Refining Co., Chicago, Ill.	Yalesville, W. T. McKenzie
			Guaranty
			Average of these 14 analyses
			Average digestible
10935	Flint Gluten Feed	Flint Mill Co., Milwaukee	South Norwalk, M. T. Hatch
11200	“ “ “	Flint Mill Co., Milwaukee	Plainville, G. W. Eaton
			Guaranty
			Average of these 2 analyses
			Average digestible
10963	Globe Gluten Feed	New York Glucose Co., New York	Norwich, A. A. Beckwith
11116	“ “ “	New York Glucose Co., New York	New Britain, Hugh Reynolds
10747	“ “ “	New York Glucose Co., New York	New Haven, R. G. Davis
11258	“ “ “	New York Glucose Co., New York	New London, E. H. Calkins
11202	“ “ “	New York Glucose Co., New York	New London, Arnold Rudd
11260	“ “ “	New York Glucose Co., New York	Willimantic, E. A. Buck & Co.
			Guaranty
			Average of these 6 analyses
			Average digestible

SAMPLED IN 1903.

Station No.	Analyses.						Price per ton.
	Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract.	
11006	10.03	1.94	22.50	7.32	54.87	3.34	$26.00
11175	9.75	1.60	25.12	7.83	52.05	3.65	26.00
11080	10.45	1.56	23.56	7.05	54.43	2.95	25.00
11198	9.59	----	23.56	----	----	3.60	27.00
10748	9.62	----	24.87	----	----	3.58	26.00
11203	8.97	----	24.25	----	----	3.47	26.00
11201	8.98	----	24.12	----	----	3.03	27.00
11199	10.73	----	22.50	----	----	2.17	27.00
11196	9.66	----	24.50	----	----	2.81	26.00
10749	9.75	----	24.25	----	----	3.46	25.00
11261	10.02	----	24.87	----	----	3.06	27.00
11197	8.75	----	25.62	----	----	3.13	26.00
	----	----	**27.5**	----	----	**3.0**	
	9.79	**1.80**	**24.21**	**7.27**	**53.80**	**3.15**	**26.00**
	----	----	**20.82**	**5.67**	**47.88**	**2.65**	
10935	8.95	0.77	19.37	6.53	61.15	3.23	27.00
11200	9.23	----	22.75	----	----	4.18	27.00
	----	----	**28.5**	----	----	**3.0**	
	9.09	**0.77**	**21.06**	**6.53**	**58.85**	**3.70**	**27.00**
	----	----	**18.11**	**5.09**	**52.38**	**3.11**	
10963	9.39	2.18	25.69	7.61	51.91	3.22	29.00
11116	10.00	1.26	26.75	7.53	51.23	3.23	26.00
10747	9.35	----	28.12	----	----	2.38	26.00
11258	8.72	----	26.25	----	----	2.36	26.00
11202	10.10	----	24.37	----	----	4.27	27.00
11260	9.48	----	24.87	----	----	2.74	26.00
	----	----	**27.0**	----	----	**3.1**	
	9.46	**1.72**	**26.01**	**7.57**	**52.21**	**3.03**	**26.60**
	----	----	**22.36**	**5.90**	**46.47**	**2.55**	

TABLE IV.—*Continued.* ANALYSES OF COMMERCIAL FEEDS.

Station No.	Name of Feed.	Manufacturer or Jobber.	Retail Dealer.
	Gluten Feed, Continued.		
11150	K. K. K. Gluten Feed	J. E. Hubinger Bros. Co., Keokuk, Ill.	New Haven, R. G. Davis
			Guaranty
			Average digestible
11061	Pekin Gluten Feed	Illinois Sugar Refining Co., Chicago, Ill.	Bristol, Geo. W. Eaton
11122	" " "	Illinois Sugar Refining Co., Chicago, Ill.	East Hartford, W. J. Cox
			Guaranty
			Average of these 2 analyses
			Average digestible
11027	Warner's Gluten Feed	Warner Sugar Refining Co., Chicago, Ill.	Avon, J. & H. Woodford
11047	" "	Warner Sugar Refining Co., Chicago, Ill.	Plainville, F. B. Newton
11235	" "	Warner Sugar Refining Co., Chicago, Ill.	Winsted, Balch & Platt
			Guaranty
			Average of these 3 analyses
			Average digestible
11026	Gluten	Manufacturer not known	New Haven, Abner Hendee
11148	Gluten Feed (no brand)	Glucose Sugar Refining Co., Chicago, Ill.	Rockville, Rockville Milling Co.
	Hominy Feed.		
11233	Hominy Feed	American Cereal Co., Chicago, Ill.	New Milford, F. R. Green
11218	" "	American Cereal Co., Chicago, Ill.	Watertown, C. W. & T. F. Atwood
11013	" "	American Hominy Co., Indianapolis, Ind.	Guilford, Morse & Landon

SAMPLED IN 1903.

Station No.	Analyses.						Price per ton.
	Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract.	
11150*	8.50	0.98	19.44	5.79	62.76	2.53	24.00
	----	----	**24.60**	----	----	**1.7**	
	----	----	**16.72**	**4.52**	**55.86**	**2.13**	
11061	8.98	1.10	26.56	7.59	51.52	4.25	26.00
11122	9.95	0.93	24.25	8.16	53.23	3.48	27.00
	---	----	**28.0**	----	----	**3.0**	
	9.46	**1.02**	**25.40**	**7.88**	**52.37**	**3.87**	**26.50**
	----	----	**21.84**	**6.15**	**46.61**	**3.25**	
11027	10.22	1.00	24.94	6.65	54.72	2.47	25.00
11047	8.70	1.12	22.87	8.51	56.15	2.65	26.00
11235	8.70	0.96	23.81	7.69	56.17	2.67	29.00
	----	----	**28.0**	----	----	**3.5**	
	9.21	**1.03**	**23.87**	**7.62**	**55.67**	**2.60**	**26.57**
	----	----	**20.5**	**5.94**	**49.53**	**2.18**	
11026	9.91	1.39	26.56	7.69	51.64	2.81	25.00
11148	8.55	1.84	23.19	7.32	55.67	3.43	26.00
11233	8.89	2.75	10.87	4.80	64.66	8.03	25.00
11218	10.14	2.60	11.37	4.74	62.97	8.18	24.00
11013	11.31	2.18	10.62	3.06	66.39	6.44	26.00

* See note on page 384.

TABLE IV.—*Continued.* ANALYSES OF COMMERCIAL FEEDS.

Station No.	Name of Feed.	Manufacturer or Jobber.	Retail Dealer.
	Hominy Feed.		
11176	Hominy Meal, D	American Hominy Co., Indianapolis, Ind.	Bridgeport, Standard Feed Co.
11093	“ Feed	Buffalo Cereal Co., Buffalo, N. Y.	Meriden, Meriden Grain & Feed Co.
10946	“ Chop	Chapin & Co., Boston, Mass.	New London, Beebe & Bragaw
11001	“	Chapin & Co., Boston, Mass.	East Haven, Hawkins & Forbes
11140	Hominy Chop, Green Diamond	Chapin & Co., Boston, Mass.	Suffield, Spencer Bros.
11163	Hominy Chop, Green Diamond	Chapin & Co., Boston, Mass.	Colchester, E. F. Strong
11057	Hominy, Niagara White Meal	Chapin & Co., Boston, Mass.	Collinsville, Collinsville Grain Co.
11125	Hominy, Niagara White Meal	Chapin & Co., Boston, Mass.	East Hartford, W. J. Cox
11043	Hominy Feed	Chas. M. Cox Co., Boston, Mass.	Plainville, F. B. Newton
11121	“ “ Worthmore	Chas. M. Cox Co., Boston, Mass.	East Hartford, G. M. White & Co.
10944	“ Chop	Hollister, Chase & Co., New York	Groton, Groton Grain Co.
11079	“	A. F. Lane, New York	North Haven, Co-op. Feed Co.
11091	“	Miner-Hillard Mill Co., Wilkesbarre, Pa.	Meriden, S. A. Billings
11106	“ Chop, Star	Miner-Hillard Mill Co., Wilkesbarre, Pa.	Berlin, J. C. Lincoln
11171	“ “ Mixed	Miner-Hillard Mill Co., Wilkesbarre, Pa.	New Canaan, C. H. Fairty
11032	“ Feed	Miner-Hillard Mill Co., Wilkesbarre, Pa.	Plantsville, T. B. Atwater
11067	“ “	Miner-Hillard Mill Co., Wilkesbarre, Pa.	Bristol, Geo. W. Eaton
11145	“ Chop	Noblesville Milling Co., Noblesville, Ind.	Manchester, Manchester Elev. Co.
11077	“	Chas. Payne & Son, New York	Wallingford, E. E. Hall
10987	“	Wm. M. Payne & Son, New York	New Haven, R. G. Davis
11050	“ Star	Wm. T. Reynolds, Poughkeepsie, N. Y.	Collinsville, F. W. Konold
10942	Hominy Chop, Blue Ribbon	J. E. Soper & Co., Boston, Mass.	Stonington, S. H. Chesebro
11103	Hominy Feed	Suffern, Hunt & Co., Decatur, Ill.	Berlin, J. C. Lincoln
10966	“ Chop	The Patent Cereals Co., Geneva, N. Y.	Jewett City, J. E. Leonard & Son
			Average of these 24* analyses
			Average digestible

* Excluding Nos. 11106, 11171 and 11050.

SAMPLED IN 1903.

Station No.	Analyses.						Price per ton.
	Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract.	
11176	8.98	2.46	10.31	4.15	66.45	7.65	$25.00
11093	9.97	2.72	10.31	5.29	63.36	8.35	24.00
10946	9.23	3.33	11.06	5.49	60.18	10.71	24.00
11001	9.78	2.55	10.69	4.43	65.26	7.29	24.00
11140	9.42	2.13	10.12	4.27	65.88	8.18	24.00
11163	9.09	2.49	10.44	4.03	66.06	7.89	24.00
11057	10.93	2.16	10.06	3.90	66.52	6.43	24.00
11125	9.65	3.00	10.75	3.78	63.59	9.23	25.00
11043	11.72	2.76	10.37	4.33	62.82	8.00	25.00
11121	9.30	2.35	10.31	3.51	67.30	7.23	24.00
10944	9.21	2.10	9.94	3.10	69.21	6.44	25.00
11079	10.27	2.52	10.75	3.29	65.37	7.80	24.00
11091	10.32	2.48	10.25	4.01	65.26	7.68	24.00
11106	10.87	2.99	9.31	6.63	65.60	4.60	23.00
11171	9.31	2.44	8.75	8.24	67.39	3.87	24.00
11032	9.53	2.16	10.00	3.82	67.66	6.83	25.00
11067	9.85	2.33	10.12	3.73	66.96	7.01	24.00
11145	9.32	2.90	10.81	3.79	63.85	9.33	24.00
11077	9.46	2.60	10.75	3.96	65.53	7.70	24.00
10987	10.57	2.60	10.69	3.99	64.48	7.67	20.00
11050	9.65	2.49	8.56	10.17	62.91	6.22	24.00
10942	8.59	2.42	10.50	3.94	66.86	7.69	26.00
11103	10.37	2.71	10.06	3.87	64.94	8.05	25.00
10966	9.43	2.79	10.62	3.84	64.54	8.78	24.00
	9.80 ----	**2.54** ----	**10.49** **7.13**	**4.05** ----	**65.27** **62.01**	**7.85** **7.22**	**24.28** ----

TABLE IV.—*Continued.* ANALYSES OF COMMERCIAL FEEDS.

Station No.	Name of Feed.	Manufacturer or Jobber.	Retail Dealer.
	RYE PRODUCTS.		
11082	Rye Bran	Abner Hendee, New Haven	North Haven, Co-op. Feed Co.
11023	Rye Feed	Oneonta Mill Co., Oneonta, N. Y.	New Haven, Abner Hendee
11242	“ “	Oneonta Mill Co., Oneonta, N. Y.	Torrington, E. H. Talcott
11183	“ Bran	Miner-Hillard Mill Co., Wilkesbarre, Pa.	Ansonia, Ansonia Flour & Grain Co.
11244	“ “	Miner-Hillard Mill Co., Wilkesbarre, Pa.	Thomaston, L. E. Blackmer
11102	“ Feed	Smith, Northam & Co., Hartford	Meriden, A. H. Cashen
11123	“ “	J. E. Soper & Co., Boston	East Hartford, G. M. White & Co.
11112	“ Bran	H. D. Stone Milling Co., Rochester, N. Y.	New Britain, C. W. Lines Co.
11128	“ Feed	H. D. Stone Milling Co., Rochester, N. Y.	Hartford, Smith, Northam & Co.
			Average of these 9 analyses
			Average digestible
	BARLEY PRODUCTS.		
11165	Barley Sprouts	Hollister, Chase & Co., New York	Stamford, Scofield & Miller
11230	“ “	E. P. Mueller, Milwaukee, Wis.	Danbury, F. C. Benjamin & Co.
10985	Malt “	E. P. Mueller, Milwaukee, Wis.	New Haven, R. G. Davis
11257	Barley “	Hollister, Chase & Co., New York	Plainville, Geo. W. Eaton
			Average of these 3* analyses
	Distillery Grains.		Average digestible
11159	Ajax Flakes	Chapin & Co., Boston, Mass.	Colchester, E. F. Strong
10980	“ “	Chapin & Co., Boston, Mass.	Putnam, F. M. Coles & Co.
11055	“ “	Chapin & Co., Boston, Mass.	Collinsville, Collinsville Grain Co.
10960	Distillers Grains, Hall's AAAA	Robert E. Hall & Co., Cincinnati, Ohio	Norwich, Norwich Grain Co.
			Guaranty
			Average of the 3 analyses of Ajax Flakes
			Average digestible
	OAT PRODUCTS.		
11002	Ground Oats	Hawkins & Forbes, East Haven	East Haven, Hawkins & Forbes
11219	“ “	C. W. & T. F. Atwood, Watertown	Watertown, C. W. & T. F. Atwood
11179	Berkshire Victor Oat Feed	Berkshire Mills, Bridgeport	Bridgeport, Berkshire Mills
11149	Oat Feed	C. M. Cox Co., Boston, Mass.	New Haven, R. G. Davis

* Excluding No. 11165.

SAMPLED IN 1903.

Station No.	Analyses.						Price per ton.
	Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract.	
11082	12.77	3.93	15.50	4.13	60.56	3.11	$27.00
11023	11.42	4.03	15.19	5.09	61.18	3.09	23.00
11242	11.59	3.90	14.81	5.00	61.53	3.17	26.00
11183	10.87	4.02	17.12	4.47	60.24	3.28	27.00
11244	10.92	3.43	15.62	3.80	63.13	3.10	27.00
11102	12.97	3.25	15.00	3.72	62.36	2.70	24.00
11123	11.80	5.40	16.31	6.44	56.73	3.32	23.00
11112	12.25	3.21	15.56	3.60	62.68	2.70	26.00
11128	12.52	3.06	15.00	3.58	63.09	2.75	24.00
	11.90	**3.80**	**15.57**	**4.43**	**61.28**	**3.02**	**25.22**
	----	----	**13.08**	----	**56.38**	**1.93**	----
11165	9.45	12.13	14.69	22.15	39.90	1.68	19.00
11230	6.57	6.61	27.37	14.82	43.49	1.14	19.00
10985	8.35	6.28	25.56	14.88	43.40	1.53	18.00
11257	11.00	6.12	28.81	10.94	41.13	2.00	20.00
	8.64	**6.34**	**27.25**	**13.55**	**42.66**	**1.56**	**19.00**
	----	----	----	----	----	----	----
11159	7.84	1.76	30.31	14.19	37.64	8.26	31.00
10980	7.13	1.74	32.19	12.54	32.73	13.67	29.00
11055	7.77	2.07	34.19	11.97	29.65	14.35	30.00
10960	7.23	1.91	30.56	11.71	36.08	12.51	29.00
	----	----	**33.0**	----	----	**12.0**	----
	7.58	**1.86**	**32.23**	**12.90**	**33.34**	**12.09**	**29.25**
	----	----	**25.78**	**4.30**	**22.67**	**12.09**	----
11002	10.99	3.18	10.62	9.56	61.49	4.16	33.00
11219	11.59	3.12	11.81	9.55	59.23	4.70	30.00
11179	9.67	4.26	9.19	17.05	56.80	3.03	20.00
11149	6.41	5.62	6.94	23.61	53.79	3.63	18.00

TABLE IV.—*Continued.* ANALYSES OF COMMERCIAL FEEDS.

Station No.	Name of Feed.	Manufacturer or Jobber.	Retail Dealer.
	Oat Products.		
11170	Oat Feed	C. M. Cox Co., Boston, Mass.	New Canaan, C. H. Fairty.
11174	" O. M.	C. M. Cox Co., Boston, Mass.	Bridgeport, Standard Feed Co.
11226	" "	C. M. Cox Co., Boston, Mass.	Waterbury, The Platt Mills Co.
10968	Pillsbury's Oat Feed	Pillsbury, Minneapolis, Minn.	Jewett City, J. E. Leonard & Son
11156	Royal Oat Feed	The Great Western Cereal Co., Chicago	Willimantic, H. A. Bugbee
11054	Vim Oat Feed	American Cereal Co., Chicago, Ill.	Collinsville, Collinsville Grain Co.
	Miscellaneous Mixed Feeds.		
11058	Provender	Collinsville Grain Co., Collinsville, Conn.	Collinsville, Collinsville Grain Co.
11248	"	Marsh & Newcomb, Litchfield	Litchfield, Marsh & Newcomb
11254	"	Washington Feed & Supply Co., Washington	Washington, Washington Feed & Supply Co.
			Average of the 3 analyses
			Average digestible
11025	Victor Corn and Oat Feed	American Cereal Co., Chicago, Ill.	New Haven, Abner Hendee
11028	" "	American Cereal Co., Chicago, Ill.	Avon, J. & H. Woodford
11220	" "	American Cereal Co., Chicago, Ill.	Watertown, C. W. & T. F. Atwood
			Guaranty
			Average of the 3 analyses
			Average digestible
10981	XXX Corn and Oat Feed	Buffalo Cereal Co., Buffalo, N. Y.	Putnam, F. M. Coles & Co.,
11069	" "	Buffalo Cereal Co., Buffalo, N. Y.	Bristol, W. O. Goodsell
			Guaranty
			Average of the 2 analyses
			Average digestible
11124	De-Fi Corn and Oat Feed	Ellsworth & Co., Buffalo, N. Y.	East Hartford, W. J. Cox
11217	" "	Ellsworth & Co., Buffalo, N. Y.	Ansonia, Ansonia Flour & Grain Co.
			Guaranty
			Average of the 2 analyses
			Average digestible
10936	Boss Corn and Oat Feed	Great Western Cereal Co., Chicago, Ill.	So. Norwalk, M. T. Hatch
11021	" "	Great Western Cereal Co., Chicago, Ill.	New Haven, Abner Hendee
			Guaranty
			Average of the 2 analyses
			Average digestible

SAMPLED IN 1903.

Station No.	ANALYSES.						Price per ton.
	Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract.	
11170	6.15	5.55	6.56	24.88	53.39	3.47	$20.00
11174	6.62	5.65	6.75	23.73	53.62	3.63	20.00
11226	7.76	5.70	6.31	24.50	52.08	3.65	20.00
10968	8.14	6.86	7.06	24.80	51.16	1.98	23.00
11156	8.07	6.31	6.19	25.19	52.49	1.75	20.00
11054	9.50	5.34	7.69	22.83	51.97	2.67	16.00
11058	13.10	1.87	12.31	4.00	64.54	4.18	27.00
11248	12.03	1.65	9.62	3.10	69.75	3.85	27.00
11254	11.67	1.98	9.94	4.64	67.71	4.06	27.00
	12.27	**1.83**	**10.62**	**3.91**	**67.34**	**4.03**	**27.00**
	----	----	**7.54**	**1.88**	**55.89**	**3.51**	----
11025	10.67	3.53	8.94	10.17	62.93	3.76	24.00
11028	9.81	3.79	8.81	11.04	62.18	4.37	20.00
11220	10.79	3.59	8.75	10.67	62.27	3.93	23.00
	----	----	**9.0**	----	---	**4.0**	----
	10.42	**3.64**	**8.83**	**10.63**	**62.46**	**4.02**	**22.33**
	----	----	**6.27**	**5.10**	**51.84**	**3.50**	----
10981	9.75	3.17	9.62	9.63	62.88	4.95	25.00
11069	5.10	3.27	9.69	10.24	66.47	5.23	27.00
	----	----	**9.5**	----	----	**4.5**	----
	7.43	**3.22**	**9.66**	**9.94**	**64.66**	**5.09**	----
	----	----	**6.87**	**4.77**	**53.67**	**4.42**	----
11124	9.90	3.81	8.12	13.40	62.03	2.74	23.00
11217	9.71	3.62	9.50	13.42	60.69	3.06	24.00
	----	----	**8.3**		----	**3.0**	----
	9.80	**3.72**	**8.81**	**13.41**	**61.36**	**2.90**	**23.50**
	----	----	**6.26**	**6.44**	**50.93**	**2.52**	----
10936	9.75	3.96	8.25	11.20	62.49	4.35	25.00
11021	10.45	3.63	9.06	10.35	61.72	4.79	24.00
	----	----	**8.5**	---	----	**4.0**	----
	10.10	**3.79**	**8.66**	**10.78**	**62.10**	**4.57**	**24.50**
	----	----	**6.15**	**5.17**	**51.54**	**3.98**	----

TABLE IV.—*Continued.* ANALYSES OF COMMERCIAL FEEDS.

Station No.	Name of Feed.	Manufacturer or Jobber.	Retail Dealer.
	MISCELLANEOUS MIXED FEEDS.		
11224	Durham Corn and Oat Feed	Great Western Cereal Co., Chicago, Ill.	Waterbury, I. A. Spencer
			Guaranty
			Digestible matter
	CORN, OATS AND BARLEY.		
11064	Schumachers Stock Feed	American Cereal Co., Chicago, Ill.	Bristol, Geo. W. Eaton
10993	" "	American Cereal Co., Chicago, Ill.	New Haven, J. T. Benham Est.
			Guaranty
	PROPRIETARY HORSE FEEDS.		Average of the 2 analyses
11114	Blomo Feed	Blomo M'f'g Co., New York	New Britain, C. W. Lines & Co.
			Guaranty
10988	Horse Feed	Buffalo Cereal Co., Buffalo, N. Y.	New Haven, R. G. Davis
11141	" "	Buffalo Cereal Co., Buffalo, N. Y.	Suffield, Arthur Sikes
			Guaranty
			Average of the 2 analyses
11011	H-O Horse Feed	H-O Co., Buffalo, N. Y.	Guilford, Geo. F. Walter
11024	" "	H-O Co., Buffalo, N. Y.	New Haven, Abner Hendee
			Guaranty
			Average of the 2 analyses
10998	Molasses Feed for Horses	E. P. Mueller, Milwaukee, Wis.	East Haven, Hawkins & Forbes
11222	" " "	E. P. Mueller, Milwaukee, Wis.	Waterbury, D. L. Dickinson & Son
			Guaranty
	PROPRIETARY POULTRY FEED.		Average of the 2 analyses
10941	American Poultry Feed	American Cereal Co., Chicago, Ill.	Saybrook, J. H. Day, Jr.
11147	" " "	American Cereal Co., Chicago, Ill.	Rockville, Rockville Milling Co.
			Guaranty
			Average of the 2 analyses
10991	Poultry Feed	Buffalo Cereal Co., Buffalo	New Haven, R. G. Davis
11098	" "	Buffalo Cereal Co., Buffalo	Meriden, Meriden Grain & Feed Co.
			Guaranty
			Average of the 2 analyses
11010	H-O Poultry Feed	H-O Co., Buffalo, N. Y.	Guilford, Geo. F. Walter
11060	" "	H-O Co., Buffalo, N. Y.	Bristol, Geo. W. Eaton
11097	" "	H-O Co., Buffalo, N. Y.	Meriden, Meriden Grain & Feed Co.
			Guaranty
			Average of the 3 analyses

SAMPLED IN 1903.

Station No.	Analyses.						Price per ton.
	Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract.	
11224	9.87	4.18	8.25	10.97	62.43	4.30	$24.00
	----	----	**8.3**	----	---	**3.6**	----
	----	----	**5.85**	**5.27**	**51.82**	**3.74**	----
11064	10.35	4.09	12.19	10.00	58.78	4.59	25.00
10993	9.91	4.27	11.56	9.93	59.54	4.79	26.00
	----	---	**13.0**	----	----	**5.0**	----
	10.13	**4.18**	**11.87**	**9.94**	**59.19**	**4.69**	**25.50**
11114	16.57	9.55	17.31	10.77	45.20	0.60	27.00
	----	----	**15.0**	----	----	**1.0**	----
10986	10.55	2.94	11.87	10.32	59.87	4.45	26.00
11141	9.92	3.15	11.87	10.17	60.39	4.50	26.00
	----	----	**12.0**	----	----	**4.50**	----
	10.23	**3.05**	**11.87**	**10.25**	**60.12**	**4.48**	**26.00**
11611	11.00	2.84	12.12	9.12	60.39	4.53	30.00
11024	11.04	2.80	11.94	8.65	61.57	4.00	29.00
	----	----	**12.5**	---	----	**4.50**	---
	11.02	**2.82**	**12.03**	**8.89**	**60.97**	**4.27**	**29.50**
10998	16.02	6.36	15.81	8.89	50.94	1.98	20.00
11222	14.93	6.01	16.87	8.09	52.50	1.60	25.00
	----	----	**21.8**	----	----	**2.8**	----
	15.47	**6.18**	**16.34**	**8.49**	**51.72**	**1.79**	**22.50**
10941	10.57	3.27	14.37	5.06	60.40	6.33	29.00
11147	11.40	3.10	15.50	3.65	60.82	5.53	35.00
	----	----	**14.0**	----	----	**4.5**	----
	10.98	**3.19**	**14.93**	**4.36**	**60.61**	**5.93**	**32.00**
10991	12.12	2.78	16.19	4.95	59.64	4.32	32.00
11098	10.40	3.04	16.75	5.24	59.70	4.87	34.00
	----	----	**17.0**	----	----	**5.5**	----
	11.26	**2.91**	**16.47**	**5.09**	**59.68**	**4.59**	**33.00**
11010	11.15	2.48	16.50	4.52	59.72	5.63	35.00
11060	10.48	2.59	16.75	4.42	60.08	5.68	36.00
11097	10.17	2.74	15.62	4.59	61.80	5.08	34.00
	----	----	**17.0**	----	----	**5.5**	----
	10.60	**2.60**	**16.29**	**4.51**	**60.54**	**5.46**	**35.00**

TABLE IV.—*Continued.* ANALYSES OF COMMERCIAL FEEDS.

Station No.	Name of Feed.	Manufacturer or Jobber.	Retail Dealer.
	PROPRIETARY POULTRY FEED.		
11253	Wheat Shreds	Natural Food Co., Niagara Falls, N. Y.	Washington, Washington Feed & Supply Co.
11160	Beef Scrap	The Bowker Co., Boston, Mass.	Colchester, E. F. Strong
10959	"	New England Fertz. Co., Boston, Mass.	Yantic, A. R. Manning & Co.
11146	"	The L. T. Frisbie Co., Hartford, Conn.	Manchester, Manchester Elev. Co.
11018	Bone and Meat Meal	McCoy & Best, Peekskill, N. Y.	Guilford, F. H. Rolf
10977	Meat Meal	Rogers Mfg. Co., Rockfall, Conn.	Danielson, Young Bros. Co.
11181	Spratt's Patent Beef Scrap	Newark, N. J.	Derby, Peterson-Hendee Co.
	PROPRIETARY DAIRY AND STOCK FEEDS.		
11007	Quaker Dairy Feed	American Cereal Co., Chicago, Ill.	Branford, S. V. Osborn
11030	" " "	American Cereal Co., Chicago, Ill.	Avon, J. & H. Woodford
11129	" " "	American Cereal Co., Chicago, Ill.	Hartford, Smith, Northam & Co.
11144	" " "	American Cereal Co., Chicago, Ill.	Suffield, Arthur Sikes
11251	" " "	American Cereal Co., Chicago, Ill.	Washington, Washington Feed & Supply Co.
			Guaranty
			Average of the 5 analyses
11173	Dairy Feed	Buffalo Cereal Co., Buffalo	Bridgeport, Wm. M. Terry & Co.
			Guaranty
10938	H-O Dairy Feed	H-O Co., Buffalo, N. Y.	So. Norwalk, M. T. Hatch.
11071	" "	H-O Co., Buffalo, N. Y.	Bristol, W. O. Goodsell
			Guaranty
			Average of the 2 analyses
10989	Creamery Feed	Buffalo Cereal Co., Buffalo, N. Y.	New Haven, R. G. Davis
11072	" "	Buffalo Cereal Co., Buffalo, N. Y.	Bristol, W. O. Goodsell
11096	" "	Buffalo Cereal Co., Buffalo, N. Y.	Meriden, Meriden Grain & Feed Co.
			Guaranty
			Average of the 3 analyses
11221	Dickinson's Stock Feed	D. L. Dickinson & Son, Waterbury, Conn,	Waterbury, D. L. Dickinson & Son,
			Guaranty

SAMPLED IN 1903.

Station No.	Analyses.						Price per ton.
	Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract.	
11253	7.15	1.75	11.06	1.85	76.25	1.94	$32.00
11160	7.50	29.92	43.81	----	2.67	16.10	60.00
10959	8.68	29.01	45.12	----	3.47	13.72	34.00
11146	7.62	29.04	45.19	----	3.72	14.43	50.00
11018	6.10	37.08	43.19	----	4.34	9.29	50.00
10977	6.10	49.85	27.25	----	2.49	14.31	37.00
11181	9.91	16.56	56.56	----	3.89	13.08	50.00
11007	8.81	5.26	14.75	15.34	51.95	3.89	24.00
11030	8.70	5.56	14.06	15.64	51.90	4.14	22.00
11129	8.65	5.27	14.37	16.79	51.07	3.85	23.00
11144	8.20	5.55	14.62	15.33	51.70	4.60	22.00
11251	8.47	4.90	14.31	14.57	53.98	3.77	21.00
	---	----	**14.0**	----	----	**3.5**	
	8.57	**5.31**	**14.42**	**15.53**	**52.12**	**4.05**	**22.00**
11173	8.86	2.83	14.44	13.26	55.92	4.69	26.00
	----	----	**14.0**	----	----	**4.0**	
10938	9.34	3.83	17.37	12.76	52.66	4.04	27.00
11071	10.03	3.35	17.62	11.30	52.67	5.03	27.00
	----	----	**18.0**	----	----	**4.5**	
	9.68	**3.59**	**17.49**	**12.03**	**52.68**	**4.53**	
10989	10.33	3.39	20.06	8.82	52.02	5.38	25.00
11072	9.80	3.76	20.44	10.53	49.72	5.75	27.00
11096	9.62	3.55	19.69	10.86	51.28	5.00	28.00
	----	----	**20.00**	----	----	**5.0**	
	9.92	**3.57**	**20.06**	**10.07**	**51.00**	**5.38**	**26.60**
11221	9.77	2.81	7.81	11.46	63.85	4.30	22.00
	----	----	**10.0**	----	----	**4.1**	

TABLE IV.—*Continued.* ANALYSES OF COMMERCIAL FEEDS.

Station No.	Name of Feed.	Manufacturer or Jobber.	Retail Dealer.
	PROPRIETARY DAIRY AND STOCK FEEDS.		
11092	Haskell's Stock Feed	W. H. Haskell, Toledo, Ohio	Meriden, S. A. Billings
			Guaranty
11225	Lenox Stock Feed	The Strong-Lefferts Co., New York	Waterbury, The Platt Mills Co.
11231	" "	The Strong-Lefferts Co., New York	Danbury, F. C. Benjamin & Co.
			Guaranty
			Average of the 2 analyses
10997	Blatchford's Calf Meal	J. W. Barwell, Waukegan, Ill.	New Haven, J. T. Benham Est.
			Guaranty
10978	Buckwheat Middlings	Quinnebaug Mills, Danielson	Danielson, Quinnebaug Store
11180	Gee's Ground Oil Cake Compound	G. E. Gee Grain Co., Minneapolis, Minn.	Derby, Peterson-Hendee Co.
11164	Germaline	Diamond Mill Co., Buffalo, N. Y.	Norwalk, Holmes, Keeler & Selleck

SAMPLED IN 1903.

Station No.	Analyses.						Price per ton.
	Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract. (Starch, gum, etc.)	Ether Extract.	
11092	9.45	2.60	8.87	8.96	64.32	5.80	$24.00
	----	----	**12.0**	----	----	**6.3**	
11225	15.08	2.80	9.25	7.32	61.01	4.54	24.00
11231	10.20	2.94	8.87	9.93	63.64	4.42	23.00
	----	----	**9.9**	----	----	**3.3**	
	12.64	**2.87**	**9.06**	**8.62**	**62.33**	**4.48**	**23.50**
10997	11.26	4.45	24.56	4.33	50.76	4.64	70.00
	----	----	**26.0**	----	----	**5.0**	
10978	14.90	5.10	29.06	3.23	39.94	7.77	22.00
11180	11.45	4.89	14.82	8.88	53.09	6.87	23.00
11164	7.82	3.80	12.81	5.08	68.51	1.98	26.00

OBSERVATIONS ON THE FERTILIZATION OF PEACH ORCHARDS.

By E. H. Jenkins.

An experiment on this subject was begun in 1896, in the orchard of Mr. A. E. Plant of Branford. Its progress has been noted in each of the Reports of this Station from the year 1899 to the present.

We here add the data obtained in the year 1903, with such explanation as is necessary to make them intelligible, reserving discussion of the results for the present.

There are six plots included in the test, each of about one-third of an acre and containing 48 trees. These plots have been fertilized as follows, each year, since 1896:

A 65 pounds of muriate of potash, 160 pounds of acid phosphate.
B " " " " "
and 170 pounds of cotton seed meal.
C 65 pounds of muriate of potash, 160 pounds of acid phosphate.
D 130 " " " " "
E 260 " " " " "
F 260 " high grade sulphate of potash, 160 pounds of acid phosphate.

Three and one-half bushels, 167 pounds, of slaked oyster shell lime have been annually applied to the northern half of each plot.

Until 1901, crimson clover had been sown each year, in August, on plots C, D, E and F, and had been plowed under in May.

It will be seen that Plot A has abundance of potash and phosphoric acid, but gets no nitrogenous fertilizer. Plot B has each year about 500 pounds of cotton seed meal per acre, containing 35 pounds of nitrogen, while all the other plots receive their nitrogenous fertilizer in form of crimson clover as a green manure.

Plots C, D, E should show the effects of heavy dressing with muriate of potash and F should show the comparative effects of a heavy dressing of high grade sulphate.

The southwest corner of the field, on Plot A, is the dampest part of the lot, in spite of an underground drain, and we believe Plot A is the least favorably placed of all the plots.

Each year a certain number of the trees have died and have been replaced by new ones in the spring. No case of yellows was found in the orchard until 1900.

Each spring a census of the trees which died during the last year has been made, which is as follows:

NUMBER OF DEAD TREES FOUND IN THE SPRING.

	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	Total.
Plot A........	2	12	2	1	10	4	5	6	42
B........	3	6	1	1	2	3	5	0	21
C........	2	3	1	1	7	3	3	5	25
D........	0	1	2	0	8	3	4	2	20
E........	0	1	0	0	0	0	5	1	7
F........	0	0	0	0	0	2	3	0	5
	7	23	6	3	27	15	25	14	120

Plot A has suffered most, losing five-sixths of the trees on it in eight years. This we believe, is partly due to the excess of water in the soil. Plot B has lost 21 trees, not quite one-half of the original number; C has lost more than one-half; D has lost more than three-eighths of the number originally planted, E and F seven and five trees respectively.

Of the 25 trees removed in the fall and winter of 1901-1902, 7 were on the limed end of the plots and 18 on the unlimed. Of 14 removed in 1902-1903, half were on the limed and half on the unlimed.

In 1898 there was a fine set of fruit buds, but most of the very young fruit fell later in consequence of cold storms at, and just after, setting time.

In 1899 there was an excellent set of fruit in the large orchard of which the trees above referred to form a part, while in most orchards of the State every flower bud was killed during the winter.

The crops were as follows:

PEACH CROP OF 1899. NUMBER OF BASKETS.

Plot.	A	B	C	D	E	F
No. of baskets............	65	117	81	110	155½	140½
No. of trees in bearing exclusive of Early Rivers..	20	31	23	27	36	30
Average number of baskets per tree in bearing.......	3.2	3.8	3.5	4.1	4.3	4.7

The yield of peaches in 1900 was also a very good one. The drought during the summer was severe, but by constant cultivation from late June until harvest the crop was carried through successfully.

The crops were as follows:

PEACH CROP OF 1900. NUMBER OF BASKETS.

Plot.	A	B	C	D	E	F
No. of baskets	140¼	212½	151½	190¾	279	243¾
No. of trees in bearing	25	35	29	33	44	40
Average number of baskets per tree in bearing	5.6	6.3	5.2	5.8	6.3	6.1

Immediately after harvest, one tree on B and two each on C, D and F were pulled out and burned because affected with peach yellows. In the large orchard adjoining, the loss from yellows this year was not quite 3 per cent.

The yield of peaches in 1901 was much smaller than in 1900. The season was a wet one with much warm, foggy and rainy weather during harvest, so that the loss from rot was very large.

The crops were as follows:

PEACH CROP OF 1901. NUMBER OF BASKETS.

Plot.	A	B	C	D	E	F
No. of baskets	66½	99	73¾	112¾	168	172½
No. of trees in bearing	20	30	26	31	40	37
Average number of baskets per tree in bearing	3.3	3.3	2.8	3.6	4.2	4.6

Immediately after harvest, 15 trees were pulled out of the experiment orchard and burned, because they showed signs of yellows. Two were Early Rivers, the others were Champions. Two came from Plot B, three from C, three from D, five from E and two from F.

It is noteworthy that no trees affected with yellows were found on the half plots which had been limed each year. In the adjoining orchard 320 trees, or about 11 per cent. of the whole number, were pulled because of yellows.

PEACH CROP OF 1902. NUMBER OF BASKETS.

Plot.	A	B	C	D	E	F
No. of baskets	48½	117½	64	69½	125	80½
No. of trees in bearing	31	33	31	31	33	35
Average number of baskets per tree in bearing	1.6	3.6	2.1	2.2	3.8	2.3

The first picking was made on August 22d, the last on September 8.

In the fall of 1902 only one tree was destroyed because of yellows and that stood on the limed part of Plot C.

In the spring of 1903 fourteen dead trees were removed from the plots, as shown in the table above, none of them affected with yellows.

New trees were planted in their places. There was a fair set of peaches, but a heavy northeast storm, August 27th to 30th, blew off much fruit, uprooted or broke down some trees and what fruit was left rotted badly, so that of 140 baskets gathered at one picking, only 50 could be sold.

It was clear that the trees on plot B, which received each year a dressing of cotton seed meal, made a better growth than any others and that the fruit from that plot was larger.

In addition to the fertilizers named above, nitrate of soda was put on plots E and F at the rate of 250 pounds per acre in the spring of 1903.

The effect of this was seen during the summer of 1903 in greater growth of wood and darker foliage.

The crop of 1903, which, as just stated, was seriously damaged by storm and damp weather at harvest time, was as follows:

PEACH CROP OF 1903. NUMBER OF BASKETS.

Plot.	A	B	C	D	E	F
No. of baskets	74	63	43	41	55	41
No. of trees in bearing	33	32	30	30	34	36
Average number of baskets per tree in bearing	2.2	2.0	1.4	1.4	1.6	1.1

TESTS OF THE VITALITY OF VEGETABLE SEEDS.

By E. H. Jenkins.

During the year 1902, two hundred and one samples of field and garden seeds have been tested as to their sprouting capacity for seed growers or purchasers. The tests have been made by Mr. V. L. Churchill.

The methods followed are those adopted by the Association of American Agricultural Colleges and Experiment Stations.

Large quantities of onion and sweet corn seed are raised for sale in this state and more tests of these varieties are annually made than of all other kinds taken together.

Table I presents the average, maximum and minimum vitality of all the seeds tested at the Station by the newly adopted methods. The age of the seeds given in the table is that reported by the seedsmen or growers who sent the samples. The samples were in all cases drawn by the persons sending them. Since the samples were sent by the seedsmen for their own information, and it was understood that the results of the tests were not to be published as representing the character of their goods, there was no motive for any misrepresentation as to the age of the seed. The samples for the most part undoubtedly represented cleaned seed as prepared for market.

The "percentage" of beet seed and mangel wurzel sprouting, as given in the table, is considerably over 100. To test the vitality of beet seed, one hundred "seeds" are put in the germinating apparatus and all the sprouts are counted. As each beet "seed" is a fruit which may contain from two to six separate seeds, it is evident that the possible number of sprouts may be 600. To count the actual number of seeds in the one hundred fruits examined, which would make a true percentage statement of sprouting power possible, would be extremely laborious; but the form of statement here followed is sufficiently intelligible and is justified by usage.

Table I.—Germination Tests of Seeds of Garden and Field Crops.

	Age of Seed in years, when tested.	Number of samples.	Average percentage by number of Seed sprouting.	Maximum.	Minimum.
Beans	0–1	7	86.5	100.0	56.7
	1–2	15	91.1	100.0	72.0
	2–3	8	87.0	100.0	59.0
	3–4	15	92.3	99.0	83.0
Beets	0–1	33	128.0	211.0	55.5
	1–2	25	135.6	230.0	44.5
	2–3	7	140.8	192.0	73.5
Brussels Sprouts	1–2	1	77.8	....	....
	3–4	2	18.4	36.0	0.8
Cabbage	0–1	30	82.8	95.8	44.0
	1–2	28	71.1	96.5	28.3
	2–3	5	68.3	88.0	43.0
	3–4	4	62.8	91.5	27.0
	4–5	2	64.9	85.8	44.0
	6–7	1	63.8	....	....
Carrots	0–1	39	62.7	90.8	35.0
	1–2	35	49.6	91.3	14.5
	2–3	5	43.6	54.2	31.0
Cauliflower	0–1	3	67.6	84.5	47.8
	1–2	9	56.6	93.5	27.5
	2–3	3	59.6	75.5	48.8
	3–4	1	77.3	....	....
Celery	0–1	29	53.9	83.5	8.3
	1–2	32	26.8	63.8	1.3
	2–3	11	50.9	79.3	4.8
	3–4	5	47.2	63.5	6.3
Corn, Sweet	0–1	39	69.7	99.0	18.0
	1–2	13	75.9	98.0	37.5
	2–3	4	86.5	92.0	78.0
Corn Salad	1–2	1	63.0	....	....
Cress	0–1	3	61.5	91.3	35.5
	1–2	3	51.2	69.8	40.0
Cucumbers	0–1	14	86.4	99.0	57.0
	1–2	30	73.6	99.0	18.0
	2–3	2	81.2	83.0	79.5
	3–4	4	50.4	90.5	6.4
	4–5	2	81.7	84.5	79.0
	5–6	1	80.5	....	....
	10–11	1	23.5	....	....
	11–12	1	5.5	....	....

Table I.—*Continued.* Germination Tests of Seeds of Garden and Field Crops.

	Age of Seed in years, when tested.	Number of samples.	Average percentage by number of Seed sprouting.	Maximum.	Minimum.
Dandelion	0–1	1	70.3	----	----
	1–2	2	38.7	54.5	2.30
Egg Plant	0–1	3	45.8	58.5	40.0
	1–2	1	58.5	----	----
Endive	0–1	2	50.1	53.8	46.5
	1–2	5	42.6	54.0	34.0
Kale	0–1	3	90.2	96.0	80.5
	2–3	1	6.0	----	----
	3–4	1	45.8	----	----
Kohl Rabi	1–2	4	67.8	72.3	58.8
Leek	0–1	5	81.3	86.0	76.3
	1–2	7	69.1	79.3	53.3
	2–3	1	35.5	----	----
Lettuce	0–1	55	65.3	100.0	4.3
	1–2	46	78.3	100.0	8.8
	2–3	14	76.2	98.8	23.8
	3–4	2	47.1	87.8	6.4
	4–5	1	82.0	----	----
	5–6	1	10.3	----	----
Mangel Wurzel	0–1	2	190.0	203.0	177.0
	1–2	8	89.4	176.0	20.0
	2–3	4	103.5	181.0	21.0
Musk Melon	0–1	10	77.5	100.0	28.0
	1–2	22	71.1	99.0	18.0
	2–3	6	33.2	92.5	2.5
	3–4	11	36.7	81.0	10.0
Onion, Connecticut grown	0–1	434	74.4	97.5	36.8
	1–2	107	62.8	92.8	0.8
	2–3	24	21.9	68.3	0.5
	3–4	1	59.5	----	----
California grown	0–1	89	90.5	98.0	55.8
	1–2	31	78.6	98.0	41.5
	2–3	7	66.1	91.5	22.3
	3–4	1	10.0	----	----
Parsley	0–1	4	69.4	76.8	58.8
	1–2	10	29.5	72.0	7.8
Parsnip	0–1	10	48.0	63.5	34.3
	1–2	4	15.6	42.8	2.5
	2–3	1	30.3	----	----

TABLE I. — *Continued.* GERMINATION TESTS OF SEEDS OF GARDEN AND FIELD CROPS.

	Age of Seed in years, when tested.	Number of samples.	Average percentage by number of Seed sprouting	Maximum.	Minimum.
Peas	0–1	1	45.5	----	----
	1–2	1	77.2	----	----
	3–4	2	98.5	99.0	98.0
Pepper	0–1	7	76.0	89.5	61.0
	1–2	13	51.5	76.5	7.5
Pumpkin	0–1	6	74.0	95.0	40.0
	1–2	9	59.1	92.0	1.1
	2–3	1	97.3	----	----
Radish	0–1	28	88.9	99.8	72.0
	1–2	27	68.6	98.8	4.8
	2–3	19	35.2	72.5	1.8
	3–4	15	24.9	69.5	0.0
Salsify	0–1	3	67.0	80.5	41.0
Spinach	0–1	24	82.4	94.3	59.5
	1–2	13	82.6	88.3	64.3
	2–3	3	63.4	91.5	40.0
Squash	0–1	12	87.4	100.0	68.8
	1–2	9	91.6	98.0	75.0
	3–4	13	38.8	89.0	0.5
Sunflower	1–2	1	97.5	----	----
Tomato	0–1	28	85.2	96.5	73.8
	1–2	21	80.5	96.0	55.3
	2–3	2	58.3	65.5	51.0
	3–4	4	62.8	96.2	40.5
	4–5	1	14.5	----	---
Turnip	0–1	9	95.4	98.8	88.8
	1–2	9	87.4	98.0	40.3
	2–3	3	91.0	93.3	89.5
	3–4	4	59.7	94.5	28.0
Watermelon	0–1	7	82.7	100.0	56.3
	1–2	21	47.0	88.0	0.0
	2–3	12	32.7	85.0	0.1
	3–4	2	21.5	42.0	1.0
	4–5	1	15.0	----	----
	5–6	1	69.5	----	----

Vitality of Onion Seed as affected by the Age of the Seed.

Since November 1, 1896, the Station has examined 523 samples of onion seed, less than one year old, of the crop of 1896, and of every succeeding crop. The results appear in Table II, together with those of tests of onion seeds which were more than one year old when examined. In the samples examined, the percentage by number of seed which sprouted was as follows:

TABLE II.—VITALITY OF ONION SEED.

	CONNECTICUT GROWN.		CALIFORNIA GROWN	
	No. of samples.	Per cent. sprouted.	No. of samples.	Per cent sprouted
Seed stated to be less than 1 year old	434	74.4	89	90.5
Seed stated to be between 1 and 2 years old	107	62.8	31	78.6
Seed stated to be between 2 and 3 years old	24	21.9	7	66.1
Seed stated to be between 3 and 4 years old	1	59.5	1	10.0

While the number of samples examined of California-grown seed is not large enough to make a close comparison, it is quite evident that a larger percentage of the California seed germinates than of the Connecticut seed.

Table II also shows that onion seed more than one year old, as a rule, has much less sprouting capacity than new seed, although in Table V are numerous cases of onion seed more than a year old which sprout as well as most samples of new seed. Whether the plants produced from old seed are as vigorous and productive as those from fresh seed is quite another question, on which laboratory germination tests can give no light.

Comparison of the Vitality of Crops of Connecticut-grown Onion Seed in the years 1894–1903.

The average sprouting capacity of Connecticut-grown onion seed, as determined for a number of years at this Station, has been as follows:

TABLE III.—VITALITY OF CROPS OF ONION SEED.

	No. of Samples Tested.	Average Percentage Sprouted.
In 1880	14	87.0
1894	25	82.9
1895	13	85.5
1896	44	72.4
1897	39	77.9
1898	68	69.3
1899	62	89.0
1900	77	88.5
1901	60	71.0
1902	60	80.6
1903	59	62.0

Average for 10 consecutive years, 77.9 per cent.

The sprouting capacity of the onion seed raised in 1903 is much lower than that of any other crop of onion seed, and our record growers explain this by the exceptionally wet and cold summer season of 1903.

The Sprouting Capacity of Different Varieties.

The average sprouting capacity of four varieties, of which a considerable number of samples has been tested, is as follows (only those samples are here included which were alleged to be less than one year old at the time of testing and were grown in Connecticut):

TABLE IV.—SPROUTING CAPACITY OF DIFFERENT VARIETIES OF ONION SEED.

Variety.	No. of Samples Tested.	Average Percentage of Sprouting Seed.
Yellow Globe	203	74.7
Red Globe	169	79.6
White Globe	108	76.9
White Portugal	30	70.1
Wethersfield Red	12	78.2

TABLE V.—GERMINATION TESTS MADE IN 1903 OF ONION SEED RAISED IN CONNECTICUT.

VARIETY.	Station No.	Age of Seed in years at time of testing.	Percentage of Seeds by number.		Number of days within which one-half of the sprouting Seed germinated.
			Sprouted in 14 days.	Remained hard.	
Yellow Globe, Crop of 1903..	3225	0–1	64.3	11.0	4
	3226	0–1	70.5	4.5	5
	3229	0–1	44.3	10.0	4
	3232	0–1	83.0	3.5	3
	3233	0–1	49.8	6.5	3
	3236	0–1	50.0	6.0	3
	3237	0–1	54.5	6.0	3
	3238	0–1	54.0	4.5	4
	3239	0–1	48.5	9.0	4
	3240	0–1	42.3	4.0	3
	3249	0–1	53.8	1.0	5
	3266	0–1	49.8	2.5	3
	3267	0–1	56.3	3.0	3
	3268	0–1	54.5	4.5	3
	3269	0–1	55.8	2.0	3
	3270	0–1	57.3	1.5	3
	3274	0–1	4.5	4.0	4
	3275	0–1	61.0	3.5	5
	3369	0–1	59.8	4.5	3
	3370	0–1	63.0	2.0	3
	3371	0–1	56.8	4.5	3
	3372	0–1	59.5	3.0	3
	3373	0–1	59.5	2.0	3
	3374	0–1	57.8	2.3	3
Red Globe, Crop of 1902......	3272	1–2	71.3	10.5	4
	3390	1–2	84.3	8.0	4
Crop of 1903......	3224	0–1	61.0	9.0	4
	3228	0–1	84.0	4.0	4
	3230	0–1	85.3	3.0	4
	3235	0–1	65.8	7.0	4
	3250	0–1	64.0	7.0	5
	3252	0–1	57.8	6.0	4
	3253	0–1	60.8	4.0	4
	3254	0–1	67.0	4.0	4
	3255	0–1	56.8	4.5	4
	3256	0–1	63.3	5.0	4
	3257	0–1	65.0	4.0	4
	3258	0–1	66.3	3.0	4
	3259	0–1	66.0	3.5	4
	3273	0–1	70.0	13.5	3
	3375	0–1	57.0	3.5	3
	3387	0–1	73.8	6.0	3
White Globe, Crop of 1902 ...	3388	1–2	1.0	52.5	7
	3390	1–2	82.8	8.0	4

TABLE V.—*Continued.* GERMINATION TESTS MADE IN 1903 OF ONION SEED RAISED IN CONNECTICUT.

VARIETY.	Station No.	Age of Seed in years at time of testing.	Percentage of Seeds by number.		Number of days within which one-half of the sprouting Seed germinated.
			Sprouted in 14 days.	Remained hard.	
White Globe, Crop of 1903	3231	0–1	64.5	11.0	4
	3234	0–1	75.3	5.0	4
	3244	0–1	70.5	6.5	4
	3251	0–1	65.8	3.5	3
	3260	0–1	65.5	6.5	4
	3261	0–1	64.8	6.0	4
	3262	0–1	65.8	4.0	4
	3263	0–1	63.5	3.5	4
	3264	0–1	52.0	5.0	4
	3265	0–1	56.3	3.0	4
	3271	0–1	36.8	7.5	4
	3276	0–1	70.3	6.5	5
	3365	0–1	69.8	5.5	3
	3366	0–1	64.8	11.0	3
	3367	0–1	70.3	8.5	3
	3368	0–1	71.3	5.5	3
	3389	0–1	80.5	9.0	4
White Portugal, Crop 1902	3317	1–2	77.0	9.5	4
	3355	1–2	72.3	5.7	4
Early Red Flat, Crop of 1902	3353	1–2	4.5	30.5	7
	3354	1–2	88.8	3.5	4

EXAMINATION OF BABCOCK TEST APPARATUS.

Section 4887 of the General Statutes requires that every bottle or pipette employed to determine the relative amount of butter-fat in milk or cream, to be used as a basis of payment for the latter, must be tested and marked as accurate by this Station or by the Connecticut Agricultural College.

Since the law was passed, this Station has tested, without charge to the creameries and dairymen of the state, 3,623 pieces of Babcock apparatus.

During the year covered by this report, 528 pieces have been tested, as follows:

	Number tested.	Number found inaccurate.
Pipettes	54	0
Milk-test bottles	237	0
Cream-test bottles	230	0
Acid measures	1	0
Thermometers	6	0
Total	528	

Percentage of inaccurate pieces found in 1901	2.3
" " " 1902	1.0
" " " 1903	0.0

TOBACCO WORK IN 1903.

By E. H. Jenkins.

The object of this work was to begin a selection of tobacco seed, particularly of the Sumatra variety, which would yield crops of leaf having uniform size, shape and weight, as well as desirable quality. Everyone who has examined Sumatra tobacco growing under shade must have noticed the great variety of size, shape and yield of the different plants. The seed which yielded the first crop of this variety grown in this state,—on the experiment field at Poquonock,—came from Florida. It was stated to be the second generation of Florida-grown seed; the original seed having been brought from the island of Sumatra.

But in the first Sumatra crop grown here, in 1900, and also in the second crop raised from seed of the first crop, there were at least four quite different types of plants and many individual plants intermediate between two types. Mr. DuBon, who had entire charge of the growing, found that by setting the first plants which were ready to transplant from a sowing, he got a strain of tobacco which was tolerable uniform, while those plants which grew more slowly in the bed were a very miscellaneous lot.

These differences very considerably diminish the value of the crop. It is not easy for a buyer to figure on the number of wrappers he can cut from leaves which are of all sorts of shapes, some long and pointed and others egg-shaped with rounding tips and butts, and in buying he must consider this uncertainty and allow for it in the price he offers.

If the leaves are uniform in shape, however, he can estimate closely just what he can do with the wrappers in the crop. Other things being equal, a uniform crop—one in which only one type of plant is present—will sell a good deal more readily than another which is not uniform.

No doubt the seed which we received from Florida did not represent any very pure strain or type of tobacco leaf in the first place.

Another reason for variations seen in the field is this. The Sumatra seed was sown in beds where broadleaf and Connecticut Havana seed had been sown in previous years. It seems hardly possible for the seed of a plant so sensitive to cold as the tobacco to keep its vitality, in the open, through the winter, but such is the case, as we have had occasion to observe a number of times. Therefore with the Sumatra plants came up a considerable number of broadleaf and Connecticut Havana plants, from seeds sown a year before, and these plants were, as might be expected, somewhat different in character and appearance from those which had sprouted promptly the year before. They were "mongrel" plants in many cases.

To secure a pure strain of plants, it is therefore desirable to sow the seed in beds where no other variety has been sown for at least two years.

It is quite possible, moreover, that the Sumatra tobacco, planted here, where all climatic conditions may be different from the land where it has been raised, will tend to "sport" or vary from the original type. This seems quite probable in view of the following facts.

It is stated by experienced growers that other types of leaf, Cuban for example, always change their shape, size and quality when they are grown here for a number of years from successive crops of seed produced in Connecticut.

It is certain that the leaf of both broadleaf and Connecticut Havana of favorite strains, which are named usually from the originator or grower, become gradually larger from successive crops of seed. This fact leads careful growers to lay by a large quantity of seed and use from this store as long as it keeps its vitality, usually from eight to twelve years, instead of saving seed each year for the next year's sowing; for by the latter practice the leaves will grow larger and larger year by year till their size lessens the value of the crop.

A common fault at present with our Connecticut Havana is that many of the wrappers are so large that they cut to waste: that is, after all the wrappers possible have been cut from a leaf which has cost the cigar-maker from thirty to forty or fifty cents per pound, there is left too much tobacco which can only be used for scrap at three to five cents per pound.

Probably eighteen to twenty inches is the best length of the cured fermented and seasoned Sumatra leaf as it goes to the manufacturer.

This means a length of twenty to twenty-two inches in the field, for in the curing, fermenting and seasoning process there is a shrinkage in length of one and a half to two inches in leaves of that size.

The leaf, moreover, should not taper gradually to either end, but should approach an oval or egg-shape, so as to allow of cutting four good-sized wrappers from a single leaf, leaving comparatively little behind but the "stem" or midrib.

The more good leaves of this sort *which can be fully ripened* on a single stalk, the better, of course. But the shade-grown Sumatra differs from our domestic leaf in this, that those leaves which are not perfectly ripe cannot be used for wrappers at all on account of their vile taste and are worthless for any purpose.

The above considerations have led us to believe that while growers are learning how to grow, cure, ferment and pack the crop, it is equally necessary to endeavor by selection to get a strain of Sumatra seed which will yield crops uniform in respect of type of tobacco at least and as nearly uniform and desirable in size and shape of leaf as is possible. There is a similar demand for a more careful selection of seed of our broadleaf and Havana seed varieties in order to establish and maintain the most desirable form and shape.

This work the Station has, with what facilities it could command, undertaken.

We are met at the outset by the objection that improvement by selection depends on growing crops from successive crops of seed for a term of years, but observation has taught that the leaf raised in this way becomes every year larger and will at last get too large to be desirable and defeat the aim of the work.

This objection may have some weight, but it is highly probable that among the thousands of plants in a crop there will be five, ten, or a hundred which do not yield to this tendency to increased size of leaf, but hold tenaciously to the desirable size. If desirable in other respects these are just the plants for our purpose. The flowers can readily be protected from any foreign pollen; a single plant may yield enough seed for an acre and the chances are that on that acre the next year will be found a good many plants like their parent, both in size and shape of leaf, and also in their ability to hold to the original type of plant and not change like the majority of plants.

In ordinary farm practice we save seed from any thrifty plants, which are exposed to cross-fertilization from any others in the fields, and we get a seed which represents the average plants of the whole field.

By the careful selection above proposed, on the other hand, we get the seed from what seems to us the very best plant among the eight or nine thousand on an acre, unmixed with the qualities of any other plant grown in that field.

What the possibilities regarding tobacco may be, we cannot of course tell. We know that the most astonishing and financially successful results have followed work of like kind done with the sugar beet, sorghum, wheat and corn. Plants are very pliable in the hands of a skillful breeder and can be molded in most extraordinary ways; and even with less knowledge and skill than the trained plant breeder, anyone with a clear understanding at the outset of what qualities he wants in his crop, and who strives persistently for those qualities alone with some knowledge of the ways to prevent cross-fertilization with undesirable plants and to promote it when necessary between desirable plants, may do a great deal to improve the quality of a given crop *by means of a careful selection of seed.* No one but an expert with abundant time and means can expect any practical results from experiments in hybridizing or crossing distinct types of tobacco.

From the nature of the work it is evident that there can be little to report from our first year's observations in selecting seed.

The field under shade cloth, covering one acre, was manured and fertilized properly and was set with plants from twelve different varieties of tobacco seed. It is not necessary to describe in detail the source of these. They were from crops which in the previous year had shown specially desirable qualities, particularly as to size and shape of leaf.

Seven of them were of the Sumatra type, two were Cuban, and there was one each of Connecticut broadleaf, Connecticut Havana and Kentucky White Burley.

The first settings were made May 5th, during a time of unseasonably warm and very dry weather. These started at once and did well. Those set later, May 15 to 29, when the weather had turned very cold and wet, stood still for a long time after setting and did not thrive. The season was unfavorable, being cold and wet and twice the crop began to turn yellow but was restored by a top dressing of soluble fertilizer cultivated into the soil.

Just before topping, each plot was examined very carefully by Mr. DuBon and Mr. Britton of the Station, and those plants were left untopped which seemed the most desirable as regards number, size and shape of leaves.

When the flower stalks had developed so as to begin flowering, they were again examined and from them there were selected two or three from each plot which were judged to be the very best of all. The flowers already open were cut off and the whole head was capped with a paper bag, securely fastened about the stem so that no insects of any sort could get to the flowers to carry pollen. While it seemed quite clear that the flowers were self-fertile, some of the flowers were artificially fertilized from other flowers of the same stalk. This was done several times by removing the bag and carrying pollen from the stamens of one blossom to the pistil of another with a small camel's hair brush. Other plants were not artificially pollinated or fertilized and it appeared that it was unnecessary as the flowers not artificially pollinated but covered with bags yet produced abundant seed. It was found that in damp hot weather there was some danger of destruction of the seed under the paper cap by molding, and in some cases the cap was removed after a good many flowers had set their seed and thereafter all flower buds were cut from the heads as soon as they appeared.

On the 18th of September the seed pods were harvested and stored in a dry cool place till they could be shelled and the seed bottled after screening.

We have in this way got a small quantity of seed of several strains of the Sumatra type which were thought to have special merit and this seed came in each case from the particular plant which we considered the most desirable as regards number of leaves and size and shape of leaf in the small crop of each which we were able to raise.

This seed, moreover, we know is not the result of any crossing of pollen from a number of plants, but is the product solely of the plant on which it grew. We believe that these seeds will in 1904 produce crops much more uniform in character than the corresponding crops of 1903 and that there will be some improvement also in the shape and size of leaf.

A record and tracing is kept of the size and shape of each leaf on the seed plants raised in 1903.

INDEX.

Page
Acanthia hirundinis 218
Acer dasycarpum 329
“ *pseudoplatanus* 329
Acheen pepper, composition of 158
Acholla multispinosa 221
Acid phosphate, analyses of 27–29
Actias luna 218
Actinonema rosæ 355
Adalia bipunctata 262, 265
Æcidio-spores 289
Æcidium fraxini 304
Æsculus Hippocastanum 326
Agrostis alba 355
Ajax flakes, analyses of 387, 418, 419
Alaria florida 220
Alaus oculatus 218
Albugo candidus 353
“ *Tragopogonis* 357
Alder Mite 219
Aleyrodes vaporariorum 216, 223
Alfalfa, diseases of 297
Allium Cepa 333
Allspice, definition and standard of 117
Alternaria Brassicæ 311, 331, 332, 353, 370
Althæa rosea 326
Alternaria Solani 320, 349, 365
“ *Violæ* 368
American Agricultural Chemical Co.:—
  Bradley's Complete manure for potatoes and vegetables 2, 74, 75
  “ Superphosphate 2, 58, 59
  “ Potato manure 2, 76, 77
  “ “ fertilizer 2, 82, 83
  “ Corn phosphate 2, 82, 83
  “ Farmers' new method fertilizer 2, 58, 59
  “ Eclipse phosphate 2, 62, 63
  “ Complete manure for top dressing grass and grain 2, 78, 79
  “ Niagara phosphate 2, 62, 63
  Church's Fish and potash 2, 45, 60, 61
  Crocker's Potato, hop and tobacco phosphate 2, 80, 81
  “ Ammoniated corn phosphate 2, 80, 81

Page

American Agricultural Chemical Co.:—
  Crocker's New rival fertilizer........................2, 58, 59
  Darling's Farm favorite 3, 58, 59
    " Potato manure 3, 80, 81
    " Dissolved bone and potash......................... 3, 44
    " Tobacco grower 3, 70, 71
    " Blood, bone and potash............................3, 50, 51
    " General fertilizer 3, 60, 61
  East India Complete potato manure.....................3, 70, 71
    " A. A. ammoniated superphosphate...................3, 58, 59
  Great Eastern Northern corn special...................3, 78, 79
    " Vegetable, vine and tobacco.......................3, 74, 75
    " General fertilizer 3, 58, 59
    " Grass and oats fertilizer.........................3, 84, 85
    " Garden special 3, 52, 53
  Packer's Union Gardeners' complete manure.........3, 46, 50, 51
    " Animal corn fertilizer 3, 80, 81
    " Potato manure 3, 72, 73
    " Universal fertilizer 3, 45, 62, 63
    " Wheat, oats and clover fertilizer.................3, 82, 83
  Quinnipiac Market garden manure.......................3, 54, 55
    " Phosphate 3, 58, 59
    " Potato manure 3, 76, 77
    " " phosphate 3, 80, 81
    " Corn manure 3, 80, 81
    " Climax 3, 60, 61
  Read's Practical potato special.......................3, 84, 85
    " Standard superphosphate 3, 62, 63
    " Vegetable and vine fertilizer.....................3, 76, 77
  Wheeler's Corn fertilizer 3, 84, 85
    " Potato manure 3, 78, 79
    " Havana tobacco grower.............................3, 74, 75
    " Superior truck fertilizer.........................3, 50, 51
    " Bermuda onion grower..............................3, 80, 81
    " Grass and oats fertilizer.........................3, 84, 85
  Williams & Clark's High grade special.................3, 52, 53
    " " Americus ammoniated bone superphosphate 3, 58, 59
    " " Potato phosphate 3, 78, 79
    " " Americus potato manure 3, 76, 77
    " " " Corn phosphate 3, 82, 83
  The A. A. C. Co.'s H. G. tobacco manure...........3, 64, 65, 68
    69, 70, 71, 84, 85
    " " Complete tobacco manure.........................3, 68, 69
    " " Southport XX special............................3, 50, 51
  Complete manure, with 10% potash......................3, 52, 53
  Grass and lawn top dressing...........................3, 82, 83
  Castor pomace 3, 27

Page

American Agricultural Chemical Co.:—
  Tobacco starter and grower 3, 72, 73
  Dry ground fish 3, 37, 39
  Fine ground bone 3, 38, 39
  Nitrate of soda 3, 19
  Muriate of potash 3, 34, 35
  Tankage 40, 41
American's Farmers' Fertilizer Co.:—
  American Farmers' Market garden special 4, 45, 54, 55
  " " Complete potato 4, 65, 76, 77
  " " Corn king 4, 65, 76, 77
  " " Ammoniated bone 4, 52, 53
  " " Grain grower 4, 80, 81
Ammonia, analysis of sulphate of 19
" Explanations concerning 11
Ammonic solution of copper carbonate, preparation of 294
Ampelopsis quinquefolia 369
" *tricuspidata* 328
Ancylis comptana 220, 278
Anisota senatoria 221
Anthoxanthum odoratum 361
Anthracnose of asparagus 305
" barberry 306
" bean 307
" chestnut 315
" chrysanthemum 315
" cucumber 318
" currant 319
" gooseberry 322
" grape 323
" hickory 325
" maple 329
" musk melon 330
" peppers 344
" poplar 347
" potato 347
" raspberry 353
" snapdragon 357
" spinach 358
" squash 358
" sycamore 361
" tomato 364
" violet 368
" walnut 369
" watermelon 369
" white day lily 329
Antirrhinum majus 357
Aphis, brown violet 216

Page
Aphis, cherry 220
" currant 220
" green apple 216, 217, 219, 220, 221, 259
" " appearance and life history 260
" " remedies 262
" *mali* 259
" on maple 220, 222
" pea 212, 276
" pine 223
" *pomi* 216, 217, 219, 220, 221, 259
" Rudbeckia 220
" *sorbi* 259
" woolly 217, 218, 219
" " elm 219
Apium graveolens 313
Apple aphis 216, 217, 219, 220, 221, 259
" borer 275
" diseases of 297
" maggot 275
Apple-tree tent-caterpillar 212, 221, 275
Apricot scale 212, 218, 219, 220
Aquilegia 316
Armour Fertilizer Works, The:—
Grain grower 4, 78, 79
Bone, blood and potash 4, 43, 50, 51
High grade potato 4, 72, 73
All soluble 4, 56, 57
Ammoniated bone with potash 4, 44
Bone meal 4, 38, 39
Arrenatherum avenaceum 332
Arsenate of lead 277
Arsenic 275
Asci 290
Ascochyta Fragariæ 360
" of buckwheat 310
" columbine 316
" geranium 322
" rhubarb 355
" *parasitica* 326
" *Pisi* 337
Ash, diseases of 304
Ash in feeding stuffs, explanations concerning 372
Asparagus beetle 275, 276
" twelve-spotted 213
Asparagus, diseases of 305
Asparagus officinalis 305
Aspidiotus forbesi 223
" *perniciosus* 216, 221, 222, 223

Page

Aspidiotus ulmi ... 223
Assassin bug ... 221, 222
Aster, diseases of ... 305
Asterolecanium variolosum ... 218
Attacus promethea ... 219
Aulacaspis rosæ ... 217, 219
Avena sativa ... 332
Azalea, diseases of ... 306
Babcock test apparatus, examination of ... 439
Bacillus amylovorus ... 343, 346, 352
" *omnivorus* ... 327
" *solanacearum* ... 364
" *tracheiphilus* ... 319, 331, 359
" *zeæ* ... 317
Bacteria ... 287
Bacterial spot of peach ... 337
Baldwin spot of apple ... 302
Barberry, diseases of ... 306
Barley, diseases of ... 306
" sprouts, analyses of ... 387, 418, 419
Barnes Brothers, experiments at orchards of ... 233
Beans, diseases of ... 307
Beet, diseases of ... 309
Berkshire Fertilizer Co.:—
Berkshire Complete fertilizer ... 4, 45, 46, 50, 51, 52, 53
" Potato and vegetable phosphate ... 4, 82, 83
" Ammoniated bone phosphate ... 4, 45, 62, 63
" Fine ground bone ... 4, 38, 39
Beta vulgaris ... 309, 314
Bitter rot of apple ... 297
" pear ... 342
Blackberry, diseases of ... 309
Black dot of clover ... 316
Black knot of cherry ... 314
" hazel ... 325
" plum ... 345
Black long sting ... 219
Black mold of apple ... 298
" clover ... 316
" linden ... 329
" onion ... 333, 336
" pear ... 342
" peppers ... 344
" squash ... 358
" sweet potato ... 361
Black rot of apple ... 298
" grape ... 323
" pear ... 342

Page
Black rot of quince 352
Black spot of maple 329
" onion 333
Black stem rust of oats 332
" " red top 355
" " rye 356
Blight of bean 307
" carrot 312
" corn 317
" potato 347
" tomato 364
Blomo feed, analysis of 389, 422, 423
Blood, analyses of dried.. 20
Blue grass, disease of 310
Blue mold of apple 299
Board of control, report of ix
Boardman, F. E.:—
  Boardman's Complete fertilizer for potatoes and general crops 4, 64, 68, 69
Bohl, Valentine:—
  Self-Recommending fertilizer 4, 38, 39
Bone, explanations concerning valuation of.. 15
Bone and potash, analyses of 41, 44
Bone manures, analyses and valuations..........................35, 38, 39
" cost and valuation 36
" guarantees 36
Bordeaux mixture, preparation of 293
" strong 239, 240, 243, 250, 256
Botanist, report of 279
Botryosporium pulchrum 362
Botrytis of egg plant 320
" grape 324
" onion 334
" peppers 344
Botrytis longibrachiata 362
" *vulgaris* 311, 322, 328, 330, 351, 359
Bowker Fertilizer Co.:—
  Stockbridge Special corn manure 4, 65, 78, 79
  " Potato and vegetable manure..........................4, 65, 70, 71
  " Grass top dressing 4, 64, 72, 73
  Potato and vegetable fertilizer 4, 74, 75, 84, 85
  " " phosphate 4, 84, 85
  Hill and drill phosphate 4, 58, 59
  Farm and garden phosphate, or ammoniated bone..........................4, 60, 61
  Fisherman's brand fish and potash 4, 54, 55
  Tobacco starter 4, 78, 79
  " ash elements 4, 86, 87, 88
  Complete alkaline tobacco grower..........................4, 86, 87, 88

Page

Bowker Fertilizer Co.:—
    Sure crop phosphate 4, 62, 63
    Market garden fertilizer 4, 56, 57
    Corn phosphate 4, 84, 85
    Early potato manure 4, 74, 75
    Fine ground dry fish 4, 40
    Fairfield onion fertilizer 4, 72, 73
    25% ash compound 4, 91, 92
    Nitrate of soda 4, 19
    Muriate of potash 4, 34, 35
    Fresh ground bone 4, 38, 39
    Canada hard wood ashes 4, 96, 97
    Acid phosphate 4, 28, 29
    Square brand bone and potash 4, 44
    Castor pomace 4, 27
    Gloucester fish and potash....................4, 60, 61
    Middlesex special 4, 45, 56, 57
    Special formula 50, 51
    Peruvian guano 62, 63
Box elder, disease of 310
Bran, analyses of 379, 400-403
Brassica campestris 356, 368
  " *oleracea* 310
  " *rapa* 367, 368
Bremia lactucæ 328
Brome grass, disease of.................... 310
Bromus inermis 310
  " *secalinus,* anatomy of fruit of 171
Broom corn, disease of 310
Brown aphis of violet 216
Brown beetle 222
Brown rot of apple 299
    " cherry 314
    " peach 337
    " pear 343
    " plum 345
    " quince 352
Bryobia pratensis 223
Bud moth 275
Buckwheat, diseases of 310
  " middlings, analyses of 391, 426, 427
Butter, definition and standard of 114
  " examination of suspected 156
Cabbage butterfly 271
  " diseases of 310
  " worm 271
Calico or mosaic disease of tobacco 363
California wash 256

Page

Callipterus sp.? ... 222
Callistephus hortensis ... 305
Candy, definition and standard of ... 117
Cane blight of raspberry ... 353
Canker of apples, European ... 299
" poplar ... 347
" worm ... 274, 275
Cannabis sativa, anatomy of fruit of ... 175
Capsicum annuum ... 344
Carnation, diseases of ... 311
Carphophiops amœnus ... 223
Carpocapsa pomonella ... 274
" *saltitans* ... 276
Carrot, disease of ... 312
Carya alba ... 325
Cassia, definition and standard of ... 118
Castanea sativa ... 315
Castor pomace, analyses of ... 27
Catalpa, disease of ... 313
Cayenne, definition and standard of ... 117
Cedar apples ... 301, 313
" disease of ... 313
Celery butterfly ... 221
" diseases of ... 313
Cephalothecium roseum ... 300, 343
Cerambycidæ ... 273
Cercis Canadensis ... 355
Cercospora althæina ... 326
" *Apii* ... 313, 337
" *Armoracia* ... 327
" *beticola* ... 309, 314
" *cercidicola* ... 355
" *columnare* ... 308
" *Nasturtii* ... 369
" *omphacodes* ... 345
" *Resedæ* ... 330
" *rosicola* ... 356
" *Violæ* ... 368
Cercosporella Persica ... 340
Certificate of inspection ... 206
Chain-dotted geometer ... 221, 222, 277
Chaitophorus ... 220
Chard, disease of ... 314
Checkered tussock caterpillar ... 222
Cheeses, definitions and standards of ... 114
Chermaphis abietis ... 222
Cherry *aphis* ... 220
" diseases of ... 314

Page
Cherry scale ... 223
Chess, anatomy and microscopic identification of ... 171
Chestnut disease of ... 315
Chilocorus bivulnerus ... 220
Chinese lady-beetle ... 214
Chionaspis americana ... 222, 223
" *furfurus* ... 216, 217, 222, 225
" *pinifoliæ* ... 223
Choanephora cucurbitarum ... 359
Chocolate and other products of the cocoa bean ... 123
" average composition of plain ... 125
" " " sweet ... 125
" containing milk or casein, tables of analyses of ... 133, 140
" definition and standard of plain ... 121
" " " sweet ... 121
" "Dutch process" ... 124
" found adulterated, tables of analyses of ... 132, 136, 137
" " " sweet ... 132, 136, 137
" methods of analysis of ... 130, 141–145
" method of manufacture ... 124
" not found adulterated, tables of analyses of ... 131, 134, 135
" " " sweet ... 131, 134, 135
" tables of analyses of compound ... 133, 138
Chrysanthemum, diseases of ... 315
Chrysanthemum Sinense ... 315
Chrysochus auratus ... 221
Chrysopa ... 262
" *oculata* ... 265
Cicada canicularis ... 274
" *tibicen* ... 221
Cichorium Endivia ... 321
Cingilia catenaria ... 221, 222, 277
Cinnamon, definition and standard of ... 118
Citrullus vulgaris ... 369
Cladosporium carpophilum ... 340, 346
" *cucumerinum* ... 319, 331
" *cucumeris* ... 331
" *fulvum* ... 366
" *Pæoniæ* ... 344
Claviceps of orchard grass ... 336
" timothy ... 361
Claviceps purpurea ... 310, 357
Clematis, disease of ... 316
Clematis Virginiana ... 316
Clisiocampa americana ... 217, 221, 274
Clothes moth ... 218
Clover, diseases of red ... 316
Cloves, definition and standard of ... 118

Page
Club root of cabbage 310
  " turnip 367
Coccidæ 227
Cochlearia Armoracia 326
Cocoa and cocoa products, definitions and standards of 121
  " average composition of 125
  " definition and standard of 122
  " " " sweet 122
  " products, methods of analysis of 130, 141–145
  " shells, average composition of 125
Cocoanut, pith, analysis of 98
Codling moth 275
Coe, E. Frank, Co.:—
    E. Frank Coe's Ground bone 4, 38, 39
      " H. G. ammoniated bone superphosphate 4, 60, 61
      " Fish and potash (FP) 4, 50, 51
      " Gold brand excelsior guano 4, 50, 51
      " Red brand excelsior guano 5, 45, 50, 51
      " Long Islander market garden special 5, 45, 56, 57
      " Columbian corn 5, 82, 83
      " " potato 5, 78, 79
      " Special potato manure 5, 65, 82, 83
      " Tankage 40, 41
Cæoma nitens 309
Coffee found adulterated, table of samples of 148
  " not found adulterated, table of samples of 146, 147
Coleosporium Sonchi-arvensis 305
Colletotrichum Antirrhini 357
  " *Lagenarium* 318, 330, 358, 369
  " *Lindemuthianum* 307
  " *lineola* 358
  " *nigrum* 344
  " *phomoides* 364
  " *Spinaciæ* 358
  " *Violæ-tricoloris* 368
  " of white day lily 329
Colorado potato beetle 212, 275
Columbine, diseases of 316
Condimental cattle foods, analyses of 391, 426, 427
Coniothyrium Fuckelii 354
Connecticut Board of Agriculture, reports of 273
Connecticut Fat Rendering and Fertilizer Corporation:—
    Tankage 40, 41
Connecticut Valley Orchard Co., The:—
    C. V. O. Co.'s Complete high grade fertilizer 5, 43, 50, 51
Contents, table of iii
Convallaria majalis 329
Cooper's Glue Factory, Peter:—
    Pure bone-dust 5, 38, 39

Page
Copper sulphate ... 239, 256
" preparation of solution of ... 294
Coptocycla clavata ... 219
Corn and oat feeds, analyses of ... 388, 420-423
Corn, diseases of ... 317
Cornus sps. ... 320
" *paniculata* ... 320
" *sanguinea* ... 320
Correspondence ... 203
Corrosive sublimate, preparation of solution of ... 295
Corticium vagum ... 350
Cosmos bipinnatus ... 318
Cosmos, diseases of ... 318
Cost of spraying ... 235
Cotton hull ashes, analyses of ... 93, 94
" seed, anatomy and microscopic identification of ... 180
" seed meal, analyses of ... 20-26
" " as a feed, analyses of ... 376, 398, 399
" " "choice," definition of ... 376
" " "prime," definition of ... 376
" " rules regarding choice and prime ... 21
Crab apple, disease of ... 318
Cratægus oxyacantha ... 325
Cream, definition and standard of ... 113
Crioceris asparagi ... 275, 276
" *12-punctata* ... 213,
Crowfoot, disease of ... 318
Crown or foot rot of peach ... 339
" gall of apples ... 299
" " blackberry ... 309
" " peach ... 338
" " plum ... 346
" " raspberry ... 354
" rust of oats ... 333
Cryptosporella anomala ... 325
Cucumber, diseases of ... 318
Cucumis Melo ... 330
" *sativus* ... 318
Currant aphis ... 220
" borer, imported ... 272
" " native ... 272
" diseases of ... 319
" fruit worm ... 220
Cylindrosporium Clematidis ... 316
" *Chrysanthemi* ... 315
" *Padi* ... 314, 346
Cyllene robiniæ ... 222
Cytospora Persicæ ... 339

Page

Dactylis glomerata 336
Dahlia, disease of 320
Dahlia variabilis 320
Dairy feeds, analyses of 390, 424-427
Dandelion, disease of 320
Darnel, anatomy and microscopic identification of............ 165
Daucus Carota 312
Dead limb fungus of peach.. 339
Dendrophagus globosus 309, 338, 346, 354
Dennis, E. C.:—
  Ground bone 5, 38, 39
Dewberry, diseases of 320
Diabrotica vittata 219
Dianthus barbatus 345
  " *Caryophyllus* 311
"Disparene" 276
Dissolved phosphate, analyses of.. 27
Distillers' grains, analyses of..............................387, 418, 419
Dog-day harvest fly..221, 274
Dogwood, disease of 320
Downs & Griffin:—
  Ground bone 5, 38, 39
Downy mildew of bean 307
  " cucumber 318
  " grape 324
  " lettuce 328
  " musk melon 330
  " onion 333
  " potato 347
  " radish 353
  " tomato 365
  " turnip 367
  " watermelon 370
Dragon fly 219
Dry rot of potato.. 349
Early blight of potato.. 349
Egg plant, diseases of 320
Elateridæ 268, 270
Ellsworth, F.:—
  Shoemaker's Swift-Sure superphosphate for general use, 5, 52, 53, 62, 63
  " " bone meal 5, 38, 39
  " " superphosphate for potatoes..5, 64, 72, 73
Elm, diseases of.. 321
Elm leaf-beetle 213, 218, 258
  " scale 218
Endive, diseases of 321
Entomosporium maculatum 343, 352

Page

Entomosporium Thümenii 325
Entyloma Linariæ 362
" *Physalidis* 325
Epiæschna heros 219
Epilachna borealis 217
Equipment 202
Erax bastardi 221
Ergot of brome grass.......... 310
" orchard grass 336
" rye 357
" timothy 361
Erysiphe cichoracearum 319, 320, 322, 345, 351, 357, 359
" *graminis* 306, 310
" *Liriodendri* 367
" *Polygoni* 316, 318, 337, 356, 367
Ether extract in feeding stuffs, explanations concerning.......... 373
Euchlæna luxurians 361
Eulecanium armeniacum 212, 218, 219, 220
" *cerasifex* 223
" *tulipiferæ* 216, 218
Examinations of orchards, gardens, etc. 209
Exhibits 203
Exoascus Cerasi 314
" *deformans* 340
" *mirabilis* 346
" *Pruni* 346
Eyed elater 218
Fagopyrum esculentum 310
Fairy ring of carnations.......... 311
Fall web-worm 212
Feeding stuffs, digestibility of 391
" explanations of analyses.......... 372
" law regulating sale of.......... 371
" regarding the purchase of commercial.......... 393
" uses of analyses of.......... 374
" weight of one quart of various.......... 397
Fertilizer market, review of.......... 99
Fertilizers, analyses of.......... 9
" classification of those analyzed.......... 17
" duties of manufacturers and dealers concerning.......... 1
" explanations concerning analysis and valuation.......... 11
" " " valuation of 13
" form of guarantee required.......... 2
" names of brands and manufacturers.......... 2
" sampling and collection of.......... 8
" statutes concerning commercial.......... 1
" trade values in 1903.......... 13
Fertilizing material, wholesale prices of.......... 106

Page
Fiber in feeding stuffs, explanations concerning 373
Fire blight of pear 343
" plum 346
" quince 352
"Fire worm" 274
Fish, dry ground, analyses of 37, 42
Flea-beetle, work of 220
Fleshy fungi 289
Flowers of sulphur 254
Fly speck of apple 299
Food products, definitions and standards of 108
" examined by the station 123
" law regulating manufacture and sale of 108
" report on 107
" summary of results of examination of 157
Formalin, preparation of solution of 295
Four-lined leaf-bug 219
Fraxinus sps. 304
" *Americana* 304
Frisbie, L. T. Co., The:—
Bone meal 5, 38, 39
Frost fungus of tobacco 362
" vinca 368
Frosty spots of strawberry 360
Fruit bark-beetle 220, 221, 222
Fruit mold of egg plant 320
" tomato 365
Fruit rot of egg plant 320
" strawberry 359
Fruit scald of apple 303
Fumago 264
" *vagans* 298, 329, 342
Fumigation of nursery stock 209
" trees in greenhouse 278
Fungi, classification of 287
" losses to crops caused by 285
" nature of 282
" prevention of 291
Fungicides, preparation of 292
Fungus gnats 217
Funkia subcordata 329
Fusarium of asparagus 305
" aster 305
" bean 308
" carnation 312
" egg plant 321
Fusarium Lycopersici 366
" *oxysporum* 349

Page
Fusarium Solani 349
Fusicladium of quince 352
" *dendriticum* 301
" *pirinum* .... 343.
Galerucella luteola 218
Gee's ground oil cake, analysis of 391, 426, 427
General insect review 210
Geranium, diseases of 322
Ginger, definition and standard of 118, 119
Glœosporium Berberidis 306
" *Caryæ* 325
" *fructigenum* 297
" *nervisequum* 361
" *piperatum* 344
" *Ribis* 319, 322
" *saccharini* 329
" *Venetum* 353
Glomerella rufomaculans 297, 342
Glow worm 219, 220
Glucose products, definitions and standards of 116
Gluten feed, analyses of 383, 410–415
" meal, analyses of 383, 410, 411
Gnomonia ulmea 321
Golden glow, diseases of 322
Gooseberry, diseases of 322
Gossyparia spuria 218
Gossypium herbaceum, anatomy of fruit of 180
Grain smut of broom corn 310
" sorghum 358
Grape, diseases of 323
Grapholitha sebastianiæ 276
Grey mold of carnation 311
" geranium 322
" grape 324
" lettuce 328
" marigold 330
" peppers 344
" primrose 351
Ground cherry, disease of 325
Gryllotalpa borealis 223
Guignardia Bidwellii 323
Guizotea Abyssinica, anatomy of seed of 193
Gymnoconia interstitialis 309, 320, 354
Gymnosporangium clavipes 325, 352
" *globosum* 301, 313, 343, 352
" *macropus* 301, 313, 318, 325
" *nidus-avis* 352
Hackberry leaf gall-louse 219

Page

Halisidota tessellaris 222
Hamamelistes spinosus 220
Harpiphorus maculatus 218
Hawthorn, diseases of 325
Hazel, disease of 325
Helianthus annuus 360
Heliothrips femoralis 268
" *cestri,* synonym of *H. femoralis* 268
Hellebore 272, 276
Helminthosporium inconspicuum 317
" *turcicum* 317
Hemingway, L. H.:—
Tankage 40, 41
Hemipterous eggs 223
Hemp seed, anatomy and microscopic identification of 175
Hendersonia Cydoniæ 352
Hessian fly 274
Heterosporium echinulatum 311
" *gracile* 327
Hickory bark-borer 213, 278
" disease of 325
" stem gall-louse 218, 219
Hollyhock, diseases of 326
Home mixtures, analyses of 89, 90
Hominy meal, analyses of 385, 414-417
" guarantees of 385
Honeysuckle, disease of 326
Horsechestnut, disease of 326
Horse feeds, analyses of 389, 422, 423
Horse radish, definition and standard of 119
" diseases of 326
House centipede 222
Hydrocyanic acid gas 209, 278
Hymenopterous galls 217
Ichneumon fly 274
Identification of insects 215
Indian currant, disease of 327
Insect pest law 200
Insects identified, list of 216
" sending by mail 224
Inspection of nurseries 205
Ipomæa Batatas 361
Iris cristata 327
Iris, diseases of 327
Iris Germanica 327
Isariopsis griseola 308
Ivy, disease of, Boston 328
James, Ernest L., James' bone phosphate 5, 62, 63

Page
James, Ernest L., James' ground bone........................5, 38, 39
Joynt, John, Canada hard wood ashes........................5, 96, 97
Juglans nigra 369
Juniperus Virginiana 313
Kainit, analysis of 33, 34
Katydid 217, 274
Kelsey, E. R., Bone, fish and potash........................5, 50, 51
Kerosene emulsion 232, 252, 257
Kinney safe engine 235, 244
Kœlreuteria, disease of 328
Kœlreuteria paniculata 328
Lace winged fly 265
Lachnus sp.? 222
" *strobi* 222
Lactuca sativa 328
Lady beetle 214
" spotted 217, 262
" squash 217
" twice stabbed 220
" two-spotted 262, 265
Lampong pepper, composition of 158
Lampyridæ 270
Lard, definition and standard of.............................. 112
" found adulterated, table of samples of..................153, 154
" method of examination 150
" not found adulterated, table of samples of..............151, 152
" table of samples of compound.............................. 155
Lavatera, disease of 328
Law regarding feeding stuffs 371
" relating to insect pests 200
Leaf blight of beet.. 309
" buckwheat 310
" celery 313
" chard 314
" corn 317
" hollyhock 326
" horseradish 326
" iris 327
" mignonette 330
" parsnip 337
" peach 340
" pear 343
" phlox 344
" quince 352
" violet 368
Leaf blotch of bean 308
" lily of the valley 329
" rose 355

Page
Leaf blotch of strawberry.......... 360
Leaf curl of cherry 314
" peach 340
" plum 346
Leaf molds of cabbage 311
Leaf mold of egg plant.......... 320
" horseradish 326
" musk melon 331
" mustard 332
" radish 353
" soapwort 358
" tomato 365
" watermelon 370
Leaf speck of ash 304
Leaf spot of alfalfa 297
" apple 300
" bean 308
" blackberry 309
" Boston ivy 328
" box elder 310
" buckwheat 310
" carnation 311
" celery 314
" cherry 314
" clematis 316
" clover 316
" columbine 316
" cosmos 318
" currant 319
" dewberry 320
" dogwood 320
" egg plant 320
" elm 321
" endive 321
" geranium 322
" gooseberry 322
" hawthorn 325
" hollyhock 326
" horsechestnut 326
" horseradish 327
" lettuce 328
" mahonia 329
" maple 329
" parsley 336
" pea 337
" pear 343
" phlox 345
" plum 346

Page

Leaf spot of quince 352
" raspberry 354
" red bud 355
" rhubarb 355
" rose 356
" spiræa 358
" strawberry 360
" sunflower 360
" tomato 365
" violet 368
" Virginia creeper 369
" watercress 369
Lectures 203
Leopard spot of asparagus.................................... 305
Leptosphæria Coniothyrium 354
Leptothyrium Pomi 299
Lesser Prionus 221
Lettuce, diseases of 328
Library 203
Ligustrum Japonicum 351
Lilac, disease of 329
Lily, disease of white day.................................... 329
Lily of the valley, disease of 329
Lime as a fungicide.................................... 295
Lime kiln ashes, analysis of.................................... 95
Lime and potassium sulphide................240, 243, 246, 248, 250, 256
" sulphur 237, 239, 242, 244, 246, 248, 250, 257
Lime, sulphur and copper sulphate....................248, 249, 250, 257
" " salt mixture 250, 251, 252, 256
Limothrips allii, synonym of *T. tabaci* 267
Linaria vulgaris 362
Linden, disease of.................................... 329
Linseed meal, analyses of 377, 400, 401
Liriodendron Tulipifera 367
Lister's Agricultural Chemical Works:—
 Lister's Potato manure 5
 " Pure raw bone meal 5, 38, 39
 " Special 10% potato 5, 65, 74, 75
 " Success fertilizer 5, 56, 57
 " Standard superphosphate of lime..................5, 52, 53
 " Special corn and potato 5, 65, 82, 83
 " Animal bone and potash 5, 44
Liver of sulphur 236, 238, 239, 242, 243, 244, 247, 248, 249
Localities, scale-infested 210
Locust borer 222
Lolium temulentum, anatomy of fruit of.................................... 165
London purple 275
Long-horned beetle 221

Page
Lowell Fertilizer Co., *See Swift's Lowell Fertilizer Co.*
Ludlam, Frederick, "Cecrops" or dragon tooth.............5, 45, 52, 53
" Cereal brand of cecrops fertilizer...........5, 58, 59
Luminous insect 219, 220, 268
Luna moth 218
Lyceum vulgare 330
Lycopersicum esculentum 364
MacCormack, Wm., Mad River strictly pure ground bone.......5, 38, 39
Mace, definition and standard of........................... 119
Macrosporium Brassicæ 326
" *commune* 344
" *cucumerinum* 331
" *herculeum* 326
" *parasiticum* 336
" *Porri* 333
" *Saponariæ* 358
" *sarcinæforme* 316
" *Tomato* 365
Madia sativa, anatomy of seed of........................... 190
Madia seed, anatomy and microscopic identification of.......... 190
Mahonia, disease of 329
Mahonia Japonica 329
Maize meal, analyses of.................................383, 410, 411
Malt sprouts, analyses of...............................387, 418, 419
Manchester, E. & Sons, Manchester's formula.................5, 50, 51
Mantidæ 214
Mantis religiosa 214
" Chinese 214
" European praying 214
Mapes, F. & P. G. Co., The:—
Potato manure 5, 74, 75
Tobacco starter, improved.............................5, 86, 87, 88
Tobacco manure, wrapper brand....................5, 66, 70, 71
Fruit and vine manure.....................................5, 80, 81
Economical potato manure 5, 70, 71
Vegetable manure, or complete manure for light soils.....5, 52, 53
Average soil complete manure........................6, 45, 54, 55
Corn manure 6, 76, 77
Top dresser, improved, half strength..............6, 45, 60, 61
Complete manure ("A" brand).......................6, 45, 58, 59
Dissolved bone 6, 52, 53
Cereal brand 6, 60, 61
Seeding down manure 6, 70, 71
Tobacco ash constituents..............................6, 86, 87, 88
Improved top dresser, full strength...............6, 45, 46, 54, 55
Maple aphis 220
" borer 221
" diseases of 329

Page

Marigold, disease of 330
Market quotations of fertilizer chemicals, explanations concerning 101
Marsonia Castagnei 347
" *Juglandis* 369
" *ochroleuca* 315
Matrimony vine, disease of.................................... 330
Meats and meat products, definitions and standards of.......... 111
Medicago sativa 297
Megilla maculata 217
Melampsora populina 347
Melanactes piceus 268
Metallic mold of squash.................................... 359
Mexican jumping seeds 221, 276
Microgaster fly 217
Microsphæra alni 329
" *elevata* 313
" *Loniceræ* 326
" *quercina* 332
" *Symphoricarpi* 327
Middlings, analyses of 379, 402–405
Mignonette, diseases of 330
Milk and milk products, definitions and standards of........... 112
Mite 223
Mixed wheat feed, analyses of....................................380, 404–411
Molasses, examination of samples of.................................... 156
Mold of bean 308
Mole-cricket, northern 223
Mosquitoes and malaria 276
Mosquito investigations 210
Musk melon, diseases of.................................... 330
Mustard, definition and standard of....................................119, 120
" disease of 332
Mycelium of fungi 282
Myriapod 218
Mytilaspis pomorum 216, 218, 222, 223
Myzus cerasi 220
" *ribis* 220
Nassau Fertilizer Co., Gladiator truck and potato..............6, 68, 69
" Nassau practical 6, 50, 51
Nasturtium officinale 369
National Fertilizer Co.:—
Chittenden's Market garden manure.....................6, 56, 57
" Complete 6, 45, 54, 55
" Potato phosphate 6, 78, 79
" Ammoniated bone 6, 60, 61
" Fine ground bone 6, 38, 39
" Universal phosphate 6, 62, 63
" Fish and potash 6, 54, 55

Page

National Fertilizer Co.:—
    Chittenden's H. G. special tobacco manure............6, 64, 68, 69
        "   Complete tobacco fertilizer..........6, 70, 71, 84, 85
Nectarophora pisi 212
    "   *rudbeckiæ* 220
Nectria cinnabarina 328
    "   *ditissima* 299
    "   *Ribis* 319
Negundo aceroides 310
Neocosmospora vasinfecta 331
Nicotiana Tabacum 362
Niger seed, anatomy and microscopic identification of.......... 193
Nitric acid, explanations concerning 11
Nitrogen, explanations concerning free........................ 11
    "   "   "   organic 11
    "   review of market of ammonic........................ 99
    "   "   "   nitric 99
    "   "   "   organic 100
Nitrogen-free extract in feeding stuffs, explanations concerning 373
Notes on insects 276
Notice to nurserymen 207
Nurseries, condition of 208
    "   fumigation of 209
    "   inspection of 205
    "   list of 205
Nutmeg, definition and standard of.......................... 120
Oak, disease of 332
    "   scale 218
Oat feeds, analyses of..................................387, 418–423
    "   grass, disease of 332
Oats, analyses of ground 387, 418, 419
    "   diseases of 332
Ohio Farmers' Fertilizer Co., The:—
    General crop fish guano..................................6, 62, 63
    Ammoniated bone and potash.......................... 6, 44
    Potato and tobacco special..................................6, 76, 77
Oidium Chrysanthemi 315
    "   *monilioides* 306
Oil, crude 239, 240, 243, 248, 250, 251, 256
Olds & Whipple, Complete tobacco fertilizer 6, 86, 87, 88, 89
    "   Vegetable potash 6, 92
    "   Special phosphate 6, 56, 57
    "   Potato fertilizer 6, 72, 73
Onion, diseases of 333
    "   seed, comparison of vitality of crops from 1894 to 1903... 436
    "   "   germination tests made in 1903.................. 438
    "   "   sprouting capacity of different varieties............ 437
    "   "   vitality as affected by age........................ 436

Page
Onion thrips 213, 266
Oospora scabies 309, 350, 368
Orange leaf rust of rye 357
" rust of blackberry 309
" " dewberry 320
" " raspberry 354
Orchard grass, disease of 336
Oregon wash 248, 250, 257
Organization 202
Orthesia insignis 218
Orthoptera of Connecticut 275
Orthosoma brunneum 221
Oyster-shell bark louse 216, 217, 218, 222
" lime, analyses of 95
Pachypsylla celitidis-mamma 219
Papaver somniferum, anatomy of seed of 194
Papilio polyxenes 221
Paratenodera sinensis 213, 214
Paris green 275
" burn of potato 351
Parsley, disease of 336
Parsnip, disease of 337
Pastinaca sativa 337
Pea, diseases of 337
Peach borer 217, 221, 274
" diseases of 337
" orchards, observations on fertilization of 428
" yellows 342
Pear, diseases of 342
Pear psylla 212, 220, 221, 222, 262, 275
" relationship to other insects 263
" how it injures trees 264
" appearance and life history 264
" natural enemies 265
" remedial treatment 265
Pelargonium sp. 322
Pemphigus tessellata 219
Penicillium glaucum 299
Peony, disease of 344
Pepper, composition of Acheen and Lampong 158
" definition and standard of black 120
" " " white 120
Peppers, diseases of 344
Periodical cicada 214
Perithecia 290
Peronospora parasitica 353, 367
" *Schleideni* 333
Petroselinum sativum 336

Page

Phaseolus lunatus 307
" *vulgaris* 307
Phengodes 220, 268
" *laticollis* 219, 270
Phleum pratense 361
Phlox, diseases of 344
Phlyctæa of cosmos 318
Phosphatic materials, review of market of 100
Phosphoric acid, explanations concerning available 12
" " " citrate-soluble 12
" " " insoluble 12
" " " water-soluble 11
Phosphorus, explanations concerning 11
Phragmidium subcorticium 356
Phyllachora pomigena 302, 344
" *Trifolii* 316
Phyllaphis fagi 218
Phyllosticta sps. 300
" *acericola* 329
" *hortorum* 320
" *Japonica* 329
" *Labruscæ* 323, 328, 369
" *minima* 310, 329
" *Paviæ* 326
" *phaseolina* 308
" *Violæ* 368
Phylloxera caryæcaulis 218, 219
Physalis pubescens 325
Phytophthora infestans 347, 365
" *Phaseoli* 307
Phytoptus 219
Pieris, synonym of *Pontia* 271
Piggotia Fraxini 304
Pimento, definition and standard of 117
Pine aphis 222
" scale 223
Pink mold of apple 300
" pear 343
Pink, sweet william, disease of 345
Pirus communis 342
" *Cydonia* 352
" *Ionensis* 318
" *Malus* 297
Pisum sativum 337
Plagionotus speciosus 221
Plant lice, abundance of 211
Plasmodiophora Brassicæ 310, 367
Plasmopara Cubensis 318, 330, 370

Page
Plasmopara viticola 324
Platanus occidentalis 361
Platycodon, disease of 345
Platycodon grandiflorum 345
Platyphyllum concavum 274
Plowrightia morbosa 314, 345
Plum curculio 274
" diseases of 345
" pocket of plum 346
Plumb & Winton, Ground bone.. 38, 39
Poa pratensis 310
Podosphæra leucotricha 300
" *oxyacanthæ* 314, 346
Pœcilocapsus lineatus 219
Point rot of tomato.. 367
Pole burn of tobacco.. 362
Polydesmus canadensis 270
Pontia oleracea 271
" *rapæ* 271
Poplar, diseases of 347
Poppy seed, anatomy and microscopic identification of.......... 194
Populus alba 347
Postal card bulletin 258
Potash, analyses of carbonate of.. 30
" " high grade sulphate of.................... 33, 34
" " muriate of 33, 34
" " nitrate of 18
" and magnesia, analyses of double sulphate of............ 33, 34
" explanations concerning 13
" review of market of 100
" use of carbonate in tobacco fertilizers 31
Potassium, explanation concerning 13
" sulphide 254
" " preparation of solution of 295
Potato beetle 212
" diseases of 347
Poultry feeds, analyses of 389, 422–425
Powdery mildew of apple 300
" " barley 306
" " blue grass 310
" " catalpa 313
" " cherry 314
" " chrysanthemum 315
" " columbine 316
" " crowfoot 318
" " cucumber 319
" " dahlia 320
" " dandelion 320

Page
Powdery mildew of golden glow 322
" " gooseberry 322
" " grape 324
" " honeysuckle 326
" " Indian currant 327
" " lilac 329
" " matrimony vine 330
" " oak 332
" " pea 337
" " peach 340
" " phlox 345
" " plum 346
" " pumpkin 351
" " rose 356
" " ruta-baga 356
" " salsify 357
" " squash 359
" " tulip tree 367
" " turnip 367
" " Virginia creeper 369
Primrose, disease of 351
Prionus brevicornis, synonym of *P. laticollis* 275
Privet, winter injury of 351
Promethea moth 219
Protein in feeding stuffs, explanations concerning 372
Provender, analyses of 388, 420, 421
Prunus Avium 314
" *Cerasus* 314
" *Persica* 337
" *serotina* 314
" *Virginiana* 314
Psenocerus supernotatus 272
Pseudomonas Phaseoli 307
Pseudopeziza Medicaginis 297
" *Trifolii* 316
Psylla pyricola 212, 220, 221, 222, 262
Psyllidæ 262
Publications 204
Puccinia asparagi 305
" *Chrysanthemi* 315
" *coronata* 333
" *Endiviæ* 321
" *graminis* 306, 332, 355, 356
" *Helianthi* 361
" *Iridis* 327
" *Malvacearum* 326, 328
" *rubigo-vera* 306, 357
" *Sorghi* 317

Page
Pucciniastrum Vacciniorum 306
Pump, "Eclipse" 243
" Hardie wheel outfit 203
" "Kerowater" 232
" "Success" bucket 239
Pumpkin, disease of 351
Pumps for spraying 296
Pyrethrum 272
Quercus robur 332
Quince, diseases of 352
Radish, diseases of.................... 353
Ramularia Armoraciae 326
" *rufomaculans* 310
Ranunculus sp. 318
Raphanus sativus 353
Raspberry, diseases of.................... 353
Receipts and expenditures 199
Red bud, disease of 355
" knot of currant 319
" " kœlreuteria 328
" pepper, definition and standard of.................... 117
" spider 216
" spot of sorghum 358
" top, diseases of.................... 355
Report of board of control of station.................... ix
" botanist 279
" treasurer of station.................... xiii
Reseda odorata 330
Resin Bordeaux mixture, preparation of.................... 293
Rheum Rhaponticum 355
Rhizoctonia of carnation 312
" mignonette 330
" pink 345
" platycodon 345
Rhizopus nigricans 358, 361
Rhophalosiphum violæ 216
Rhubarb, disease of 355
Rhytisma acerinum 329
Ribes rubrum 319
Robber fly 221
Rœstelia lacerata 301
" *pirata* 301
Rogers & Hubbard Co., The:—
Hubbard's Fertilizer for oats and top dressing.........6, 64, 68, 69
" '02 top-dress phosphate 6, 74, 75
" Grass and grain fertilizer 6, 70, 71
" Soluble corn manure 6, 76, 77
" Soluble potato manure 6, 64, 70, 71

Page

Rogers & Hubbard Co., The:—
  Hubbard's Soluble tobacco manure 6, 68, 69
    " All soils and all crops phosphate 6, 56, 57
    " Corn phosphate 6, 78, 79
    " Potato phosphate 6, 65, 74, 75
    " Row knuckle bone flour 6, 38, 39
    " Strictly pure fine bone 6, 38, 39
Rogers Manufacturing Co., The:—
  All round fertilizer 6, 60, 61
  Complete potato and vegetable 6, 76, 77
  Complete corn and onion 6, 65, 67, 72, 73, 84, 85
  Fish and potash 6, 56, 57
  Soluble tobacco and potato 6, 70, 71
  Oat and top dressing 6, 64, 68, 69
  Grass and grain for seeding down 6, 68, 69
  Soluble tobacco fertilizer 6, 68, 69
  Pure ground bone 6, 38, 39
  Tobacco starter 65, 67, 80, 81, 84, 85
  25% potash from vegetable sources 92
Romaleum atromarium 221
Root rot of violet 368
Rootstock rot of iris 327
Rose bugs 274
  " diseases of 355
  " scale 217, 219
Rosette of potato 350
Rot of onion 334
Rubus Canadensis 320
  " *odoratus* 354
  " *villosus* 309
Rudbeckia aphis 220
Rudbeckia laciniata 322
Russia Cement Co.:—
  Essex XXX fish and potash 6, 45, 56, 57
    " Corn fertilizer 6, 82, 83
    " Market garden and potato manure 7, 78, 79
    " A1 superphosphate 7, 45, 60, 61
    " Complete manure for corn, grain and grass 7, 72, 73
    " Complete manure for potatoes, roots and vegetables, 7, 68, 69
    " Tobacco starter 7, 74, 75
    " Special tobacco manure 7, 64, 65, 68, 69, 70, 71
    " Odorless lawn dressing 7, 45, 54, 55
    " Dry ground fish 7, 37, 42
    " Fine bone meal 7, 38, 39
Rust of ash 304
  " asparagus 305
  " aster 305
  " azalea 306
  " barberry 306

Page

Rust of beans 308
" carnation 312
" chrysanthemum 315
" clover 316
" corn 317
" crab apple 318
" endive 321
" hollyhock 326
" iris 327
" lavatera 328
" pear 343
" poplar 347
" rose 356
" sunflower 361
" tobacco 363
Rusts 289
Rusts of apple 301
" barley 306
" hawthorn 325
" quince 352
Ruta-baga, disease of 356
Rye, diseases of 356
" feed, analyses of 387, 418, 419
Rynchœnus nenuphar, synonym of *Conotrachelus nenuphar* 274
Sac fungi 290
Saddle-back caterpillar 221
Salsify, diseases of 357
Sanderson Fertilizer and Chemical Co.:—
 Sanderson's Formula A 7, 54, 55, 62, 63
 " Formula B for tobacco 7, 64, 72, 73
 " Corn superphosphate 7, 65, 84, 85
 " Potato manure 7, 65, 82, 83
 " Blood, bone and meat 7, 40, 41
 " Fine ground bone 7, 38, 39
 " Special with 10% potash 7, 45, 58, 59
 " Plain superphosphate 7, 28, 29
 Luce Bros.' Bone, fish and potash 7, 58, 59
 Nitrate of soda 7, 19
 Muriate of potash 7, 34, 35
 Double sulphate of potash 7, 34, 35
San José scale 216, 217, 221, 222, 223, 258, 275, 276, 278
" mortality of 211
San José scale-insect, fighting in 1903 (article) 233
 Spraying dormant trees 233
 Experiments at Yalesville 234
 Results at Yalesville 238
 Westville experiments 239
 Results at Westville 243

Page
San José scale-insect, spraying at Southington.................. 244
Results at Southington 248
New Haven experiments 248
Results at New Haven 250
Other experiences 250
Summer spraying with kerosene emulsion 252
Making the lime, sulphur and salt mixture............... 252
" " and sulphide of potash mixture......... 255
Effect of the lime and sulphur mixtures on the skin....... 255
Weather notes 256
Summary 256
Sanninoidea exitiosa 217, 221
Saperda bivittata, probably synonym of *S. candida* 274, 275
" *candidata*, probably synonym of *S. candida*............ 275
Saponaria officinalis 358
Saprophytes, definition of 282
Scab of apple 301
" beet 309
" cucumber 319
" musk melon 331
" peach 340
" pear 343
" peony 344
" plum 346
" potato 350
" quince 352
" tomato 366
" turnip 368
Scale-insects of the orchard, two common (article) 225
" apricot 212, 218, 219, 220
" cherry 223
" elm 218
" oak 218
" oyster-shell 216, 217, 218, 222, 223, 225
" pine 223
" rose 217, 219
" San José 216, 217, 221, 222, 223, 258, 275, 276, 278
" scurfy 216, 217, 222, 225
" tulip tree 216, 218
" white 222, 223
Schizoneura americana 219
" *lanigera* 217
Schizura unicornis 220
Schmitt boxes 202
Schumacher's stock feed, analyses of.................... 389, 422, 423
Sclerotinia bulborum 334
" *fructigena* 299, 314, 337, 343, 345, 352
Scolecotrichum melophthorum 331

Page
Scolytidæ 278
Scolytus quadrispinosus 278
" *rugulosus* 220, 221, 222
Scurfy bark-louse 216, 217, 222
Scutigera forceps 222
Secale cereale 356
Seed bed rot of tobacco 362
Seeds, tests of vitality of 432
Selandria cerasi 274
Senator moth 221
Septoria of cosmos 318
" of phlox 344
" *consimilis* 328
" *cornicola* 320
" *Dianthi* 311
" *Helianthi* 360
" *Lycopersici* 365
" *Petroselini* 314, 336
" *piricola* 343
" *Ribis* 319, 322
" *Rubi* 309, 320, 354
" *Ulmariæ* 358
Sesame seed, anatomy and microscopic identification of 187
Sesamum indicum, anatomy of fruit of 187
Sesia tipuliformis 272
Shay, C. M., Mystic gilt edge potato manure 7, 64, 68, 69
Pure ground bone 7, 38, 39
Corn manure 7, 74, 75
Sheep manure, analyses of 95, 96, 97
Shoemaker, M. L. & Co., *See Ellsworth, F.*
Shot-hole of plum 346
Sibine stimulea 221
Sirups, definitions and standards of 115
Sleeping disease of tomato 366
Slime molds 287
Smuts 288
Smuts of barley 306
Smut of corn 317
" oat grass 332
" oats 333
" onion 334
" red top 355
" rye 357
" sweet vernal grass 361
" teosinte 361
" timothy 361
Snake, ground 223
Snapdragon, disease of 357

Page
Soap and water 232
“ whale-oil 232
Soapwort, disease of 358
Soda, analyses of nitrate of 18
“ bordeaux, preparation of 293
Soft rot of cabbage 311
Solanum Melongena 320
“ *tuberosum* 347
Soldier beetle 222
Sooty blotch of apple 302
“ pear 344
Sorghum, diseases of 358
Sorghum vulgare 310, 358
Special manures, analyses of 64–85
“ cost and valuation of 67
“ guarantees of 64
Spermatia 289
Sphaceloma ampelinum 323
Sphacelotheca Sorghi 310, 358
Sphærella Fragariæ 360
“ *rubina* 353
Sphæropsis Malorum 298, 342, 352
Sphærotheca Castagnei 320
“ *Humuli* 356
“ *mors-uvæ* 322
“ *pannosa* 340, 356
Spices, definitions and standards of 117
Spilosoma virginica 218
Spinach, disease of 358
Spinacia oleracea 358
Spiny elm caterpillar 219
Spiræa, disease of 358
Spiræa Ulmariæ 358
Spirobolus marginatus 218
Spores of fungi 283
Sporotrichum globuliferum 321
Spot disease of violet 368
Spot of tobacco 363
Spotted lady beetle 217
Spray injury of apple 303
“ musk melon 332
“ peach 341
Spraying machinery 296
Spruce bud-louse 222
Squash beetle 217
“ diseases of 358
Station, announcement of objects of vii
“ officers and staff of ii

Page
Station, report of board of control of ix
" treasurer, report of xiii
Steam cooking plant 235
Stem and leaf rot of geranium........................ 322
Stem rot of aster 305
" carnation 312
" golden glow 322
" mignonette 330
" onion 334
" pink 345
" platycodon 345
Stem spot of cosmos........................ 318
Strawberry, diseases of 359
" leaf-roller 220, 278
" saw-fly 218
Striped squash beetle 219
Submittal, letter of 199
Sugars and related substances, definitions and standards of...... 115
Sulphide of potash 255
Sulphur as a fungicide 295
" flour 254
" flowers 254
Summer spores of fungi 283
Sun burn of musk melon 332
Sunflower, diseases of 360
Superphosphates, analyses of nitrogenous 43–63
" cost and valuation of nitrogenous 47
" guarantees of nitrogenous 43
Sweet potato, disease of 361
" vernal grass, disease of 361
Swift's Lowell Fertilizer Co.:—
Swift's Lowell Potato phosphate 7, 72, 73
" Potato manure 7, 80, 81
" Bone fertilizer 7, 60, 61
" Animal brand 7, 56, 57
" Dissolved bone and potash 7, 44
" Ground bone 7, 38, 39
" Market garden manure 7, 56, 57
" Perfect tobacco grower 7, 74, 75
" Tankage 40, 41
Sycamore, disease of 361
Symphoricarpus vulgaris 327
Syringa vulgaris 329
Syrphus fly 262
Tankage, analyses of garbage 98
" explanations concerning valuation of 15
" slaughter-house 37, 40, 41
Taraxacum officinale 320

Page

Telephorus carolinus 222

Teleuto-spores 289

Tent caterpillar 212, 217, 221, 275

Teosinte, disease of 361

Tetranychus telarius 216

Thalessa atrata 219

Thielavia basicola 368

Thread fungi 288

Thripidæ 267

Thrips tabaci 213, 266

" *alii*, synonym of *T. tabaci* 267

" on grape 274

Tilletia Anthoxanthi 361

Timothy, diseases of 361

Tinea 218

Tip burn of potato 351

Toadflax, disease of 362

Tobacco, diseases of 362

" insects, study of 210

" manures claimed to contain potash as carbonate.... 86

" stalks, analyses of ashes of 93

" stems, analysis of 91

" work in 1903.... 440

Tomato, diseases of 364

Tortoise beetle 219

Trade values of fertilizers in 1903 13

Tragopogon porrifolius 357

Trifolium incarnatum 316

" *pratense* 316

" *repens* 316

Tubercularia vulgaris 319

Tulip tree, disease of 367

" scale 216, 218

Turnip, diseases of 367

Twice-stabbed lady beetle 220

Two-spotted lady beetle 262, 265

Ulmus Americana 321

Uncinula necator 324, 369

Unicorn caterpillar 220

"Unit," explanation of term.... 102

Uredo Iridis 327

Uredo-spores 289

Urocystis Cepulæ 334

" *occulta* 357

Uromyces appendiculatus 308

" *caryophyllinus* 312

" *Trifolii* 316

Ustilago Avenæ 333

Page
Ustilago Hordei 307
“ *levis* 333
“ *nuda* 306
“ *perennans* 332
“ *striæformis* 355, 361
“ *Zeæ* 317, 361
Valuation of fertilizers, explanations concerning 13
“ “ uses and limitations of 15
Valuation of mixed fertilizers, explanations concerning 14
Vanessa antiopa 219
Vegetable ash and ash compounds, analyses of 91, 92
Venturia inaequalis 301
“ *pirina* 343
Vermicularia circinans 333
“ of potato 347
Vermorel nozzle 243
Vinca, disease of 368
Vinca major 368
Vine “fretter” 274
Vinegar, examination of samples of 156
Viola odorata 368
Violet, diseases of 368
Virgin moth 218
Virginia creeper, diseases of 369
Walnut, disease of 369
Water (hot), as a fungicide 295
“ in feeding stuffs, explanations concerning 372
Watercress, disease of 369
Watermelon, diseases of 369
Wet rot of potato 350
Wheat bran, analyses of 379, 400–403
“ feeds, average composition of 381
“ “ guarantees of 382
“ middlings, analyses of 379, 402–405
White arsenic 275
“ blast of onions 266
White-fly 216, 223
White fungus of elm 321
“ rust of radish 353
“ “ salsify 357
“ scale 222
“ smut of ground cherry 325
“ “ toadflax 362
Whitewash 239, 241, 243, 244, 245, 248, 249, 250, 256
Wilcox Fertilizer Works:—
Wilcox’s Potato, onion, and tobacco manure 7, 70, 71
“ Potato manure 7, 72, 73
“ Complete bone superphosphate 7, 54, 55

Page

Wilcox Fertilizer Works:—
  Wilcox's Special superphosphate 7, 56, 57
    " High grade fish and potash 7, 52, 53
    " Fish and potash 7, 52, 53
    " Grass fertilizer 7, 72, 73
    " Dry ground fish 7, 40
    " Pure ground bone 7, 38, 39
    " Nitrate of soda 7, 19
    " Acid phosphate 7, 28, 29
    " Muriate of potash 7, 34, 35
Wilt of carnation 312
  " cucumber 319
  " egg plant 321
  " musk melon 331
  " raspberry 354
  " squash 359
  " tomato 366
Winter injury of apple 303
  " " grape 324
  " " peach 341
  " " plants 280
  " spores of fungi 283
Wood ashes, analyses of 94, 96, 97
Woodruff, S. D. & Sons, Home-mixed fertilizer...............7, 90, 91
Woolly aphis 217, 218, 219
  " elm aphis 219
Xyleborus celsus 222, 278
Yellow leg of onion 336
Yellows of aster 306
  " peach 342
  " raspberry 355
Zea Mays 317

ERRATA.

Page 127, eighth line from top, for 1892 read 1902.

Page 217, seventh line from bottom, for *Chinaspis,* read *Chionaspis.*

Page 318, third line from top, for Cosmos, *Cosmos bipinnatus,* read Cornflower, *Centaurea Cyanus;* eighth line from top, for *Cosmus*, read *Cosmos.*

Page 346, first line from top, for *blobosus,* read *globosus.*